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MINERALOGICAL TABLES,

DESCRIBING THE

PHYSICAL AND CHEMICAL PROPERTIES

OF ALL THE

IMPORTANT MINERALS.

BY

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CAIUS COLL., CAMBRIDGE.



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PREFACE.

THESE Tables, in their original form, were compiled for my own use, when studying at the Royal School of Mines. I considered that, with a little alteration and extension, they might prove useful to others. They are intended, firstly, to assist the student, to whom they present, in a concise form, a quantity of matter from various scattered sources; and secondly, to serve as a handbook for collectors and those viewing collections.

The Crystallography adopted is that propounded by Professor Naumann, for although it may not be the most scientific, it is undoubtedly the simplest system yet put forward. The classification of the minerals is, with slight modifications, that adopted by Dana.

The introductory portion is necessarily brief, yet it is hoped that it will be found to contain all the information required to understand the Tables.

My best thanks are due to Professor Warington Smyth, of the Royal School of Mines, for permitting me to make use of my notes of his Lectures, and for suggesting some improvements.

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INTRODUCTION.

Definition and Scope of the Science.—Mineralogy is the science which treats of the constituents of rocks, as distinct from Geology, which treats of the rock masses themselves; thus Granite is a *rock*, while the materials of which it is composed—viz., felspar, mica, and quartz—are *minerals*. If we wish to know what minerals are composed of, we must have recourse to Chemistry, which enables us to reduce a substance to its ultimate elements. Some authorities consider Mineralogy to be a branch of Chemistry, and certainly the one involves the other to a great extent, yet, for the sake of simplicity, it is more convenient to regard it as a separate science.

Mineralogy has for its objects the identification, description, and classification of all mineral or inorganic substances.

When we consider the great commercial value of some of these, such as coal, rock-salt, and the metallic ores, we shall perceive that the study of Mineralogy is of the highest practical importance.

In its relations to Geology, it has also a theoretical interest, as helping to explain the structure of rocks, and the processes by which many of these have been formed.

Definition of a Mineral.—A mineral is an inorganic substance devoid of life, and increasing in size only by additions from without. It may occur in definite figures, bounded by straight lines; it has the same structure throughout, and it should have a definite chemical composition, though this may vary within certain limits. We find, however, in practice, that we cannot adhere strictly to the above definition. Thus,

according to that definition, we must exclude coal, which we know to be of vegetable origin; yet it is now so far removed from its original condition, and has so completely assumed the properties of a mineral, that we are quite justified in calling it one.

Identification of Minerals.—In identifying a mineral, the following are the chief points to be considered:—

1. *Form.*—Many minerals occur in definite geometrical shapes, called *crystals*, and these vary in size, being sometimes exceedingly minute and sometimes attaining a length of one or two feet. A crystal is defined to be “a solid inorganic body, formed by natural laws, in a more or less polygonal form.” When a mineral exhibits distinct and well-developed crystals it is said to be *crystallised*; when it is made up of a number of minute and imperfectly formed crystals, like loaf sugar, it is said to be *crystalline*. The same substance may occur in both states; thus, carbonate of lime occurs crystallised as calcite, and crystalline as marble. Some few minerals exhibit no definite form whatever, but occur simply in shapeless masses. Such minerals are said to be *amorphous*.

It is frequently found that minerals put on a variety of curious imitative shapes, owing to a peculiar arrangement of the crystals. The following are some of the technical terms and their abbreviations, used in describing their peculiarities:—

+ *Acicular* (acic.); occurring in fine needle-shaped crystals.

Basillary (bas.); when the crystals are grouped symmetrically round a common axis.

Botryoidal (bot.); arranged in clusters, like bunches of grapes.

Columnar (col.); arranged in columns lying side by side, like basalt.

Capillary (cap.); in thin hair-like crystals.

Dendriform (dend.); this term is applied when the mineral occurs branched like a tree, or often like a fern.

Fibrous (fib.); composed of fibres, like asbestos.

Foliated (fol.); a mineral is said to be foliated when thin leaves or laminae can be split off the mass.

Granular (gran.); made up of small grains like oolite. When a mineral does not exhibit any granular structure, but is dense and brittle, it is said to be *compact*.

Lamellar (lam.); made up of thin leaves or laminae.

Prismatic (pris.); constructed of prisms.

Plumose (plu.); arranged like a bunch of feathers.

Reniform (ren.); occurring in kidney-shaped masses.

Reticulated (ret.); in thin crystals arranged like wire gauze.

Stellated (stell.); arranged in star-like patterns.

The following are some other terms used in describing the physical condition of Minerals:—

Sectile (sect.); easily cut with a knife, without breaking irregularly.

Brittle (brit.); easily broken up by hammering. The Diamond is the hardest of all stones, but it is exceedingly brittle.

Flexible (flex.). A mineral is flexible when it may be bent without breaking it. This property is seen in laminated minerals, such as Talc.

Elastic (elast.). When a flexible mineral is bent, and springs back to its original position, it is said to be elastic. Mica is an example.

Ductile (duct.). Capable of being drawn out into wire.

Malleable (mall.). Capable of being hammered out into thin sheets, like native copper and gold.

It must be borne in mind that minerals often occur uncrystallised and in indefinite shapes on the large scale, whereas distinct crystals may be found in small specimens. We shall return to the subject of crystallisation when speaking of Crystallography.

2. *Cleavage*.—It is found that a mineral splits or cleaves more readily in one direction than in any

other. This is called its cleavage, and the direction in which it cleaves is called the *plane of cleavage*.

3. *Hardness*.—This affords a good and easily-applied test. Of two minerals, that one is the harder which will scratch the other. Since, however, hardness is only a relative term, it is necessary to establish a series of standards with which we may compare the mineral to be tested. The scale usually adopted is the following :—

	Hardness.	Substance.
Scratched by the Nail	1.	Graphite, or Talc.
	2.	Rock-salt, or Mica.
	3.	Calc-spar.
Scratched by Knife or File.	4.	Fluor-spar.
	5.	Apatite.
	6.	Orthoclase Felspar.
Cannot be Scratched by Knife or File.	7.	Quartz (Rock-crystal).
	8.	Topaz.
	9.	Corundum, or Sapphire.
	10.	Diamond.

Any mineral in this scale can scratch any other above it, but is itself scratched by any one below it. To apply this test, the unknown mineral is subjected to each of these substances in turn, until one is met with which will scratch it. Thus, a mineral that will scratch Apatite, but is scratched by Felspar, is said to be of hardness 5.5. The number of minerals (excluding rare varieties) corresponding to each degree of hardness, is as follows :—No. 1—23 ; No. 2—90 ; No. 3—71 ; No. 4—53 ; No. 5—43 ; No. 6—52 ; No. 7—26 ; No. 8—6 ; No. 9—1 ; No. 10—1.

4. *Specific Gravity*.—By this is meant the weight of a given bulk of a substance, as compared with the weight of an equal bulk of water. In the following Tables the hardness and specific gravity of each mineral are given, the two together being important tests in distinguishing minerals.

5. *Chemical Composition*.—This can only be ascertained by analysis. Some minerals consist entirely of one element, as the Diamond, which consists of pure carbon ; others consist of a combination of two or

three elements, as Fluor-spar, which consists of calcium and fluorine ; and Gypsum, which consists of calcium, sulphur, and oxygen. There are other minerals, the composition of which is much more complex, as they consist of six or eight elements in combination. In such instances, we find considerable variation in composition exists even in the same mineral, so that different specimens exhibit a different constitution, and it therefore becomes a matter of difficulty to frame a formula for them. Even in these cases, however, certain elements in the mineral always remain constant, while others vary considerably. Thus it is found that in many minerals the oxides of calcium, magnesium, potassium, and sodium seem to replace each other indifferently, and without altering materially the general properties of the mineral.

6. *Colour*.—Some minerals possess a special colour, which helps to recognize them. Thus Celestine is of a pale blue, and Sulphur of a bright yellow colour ; but others vary in colour in different specimens. This variation is due, in most instances, to the absence or presence of certain metallic oxides, such as those of iron and manganese. The Diamond occurs colourless ; also grey, blue, rose-pink, and black. Hence colour is not to be considered a safe test in identifying a mineral ; it must be taken only in conjunction with other more constant characters:

7. *Streak*.—When a mineral is scratched, the colour of the scratched surface frequently differs from that of the original surface ; and if the abraded powder be rubbed on paper, it leaves a mark of a peculiar colour. This is called the streak, and in some of the metallic minerals it is very characteristic.

8. *Lustre*.—Most minerals possess some degree of lustre, and the precious stones exhibit this property in a marked manner. The following terms are used to signify different qualities of lustre :—

Metallic (met.) ; having the lustre of metals, like Zinc or Tin.

Adamantine (admt.); this is the most brilliant degree of lustre, like that of the Diamond.

Vitreous (vit.); the lustre of glass, like that exhibited by Quartz.

Resinous (res.); having an oily lustre, like Resin, exhibited by the Garnet.

Fatty (fat.); having a greasy aspect, generally seen in minerals allied to Talc.

Pearly (ply.); having a lustre, like Mother-of-Pearl—example, Mica.

Silky (sky.); the lustre possessed by fibrous minerals, like Asbestos.

Splendent (splen.); reflecting light very strongly, like Galena.

Glistening (glist.); when light is reflected from small scattered surfaces, and no images are formed.

Shining (shin.); when indistinct images are formed, as seen in Heavy-spar.

Dull, or Earthy; when the mineral is devoid of lustre, like Chalk.

9 (1). *Optical Properties*.—A mineral is said to be *transparent* (transpt.) when it allows light to pass freely through it, and distinct forms can be seen through it. When a mineral partially obstructs the passage of light, and allows only the outlines of things to be seen through it, it is said to be *translucent* (translt.). A mineral is *opaque* (ope.) when it entirely prevents the passage of light.

(2.) Most transparent minerals give only one impression of the object looked at—that is, they exhibit *single refraction*; but some (notably Iceland-spar, a variety of Calcite) exhibit *double refraction*, giving two impressions of any object looked at through them. It is worthy of remark that all transparent minerals of the cubical system exhibit only single refraction. In the section on Crystallography we shall return to the subject of refraction, and refer to the kindred phenomenon of polarization.

(3.) When the Diamond has been exposed for some time to bright sunlight, and is suddenly removed to a dark place, it is found to emit a light of its own of varying intensity and duration. This property is known as *Phosphorescence*, and it is observed in a smaller degree in other minerals, as Arragonite, Calcite, and Chalk. It may be induced by friction in Quartz, and by heat in the Topaz, and some varieties of Fluor-spar.

(4.) Some crystals exhibit different colours when light is transmitted through them in different directions. Thus Tourmaline exhibits two different colours when light is transmitted through a crystal in two different directions. This property is termed *Dichroism*, and Tourmaline is said to be *Dichromatic*. Other crystals, such as those of Diaspore, Andalusite, and Axinite, exhibit *Trichroism*, or three different colours. Crystals of the cubical system are always *Mono-chromatic*.

(5.) Many opaque crystals reflect light in such a manner as to produce a number of varying shades when they are moved about in the hand, so that the light may fall on them at a certain angle. This *play of colours*, as it is called, is very beautifully shown in Labradorite, and also in the Opal. The Sapphire, when cut transversely to its principal axis, exhibits a star with six rays. Minerals, exhibiting a bright slit of light, like the cat's-eye variety of Quartz, are said to be *chatoyant*; those which show a variety of colours, due to the presence of the thin films of metallic oxides, are said to be *iridescent* (irid.).

10. *Blow-pipe Testing*.—This is an extremely important department of Mineralogy, as the blow-pipe affords a ready means of testing the nature of a mineral. Some minerals fuse readily before the blow-pipe, others only with difficulty, and others again cannot be fused without the aid of some easily-fusible substance termed a *Flux*. Carbonate of soda and borax are commonly used as fluxes. Metallic minerals may be reduced to

the metallic state by placing a portion of the powdered mineral on charcoal, and subjecting it to the inner or reducing flame of the blow-pipe. In some cases it is necessary to aid the reduction by adding a little carbonate of soda. Other phenomena occur when the mineral is heated on charcoal, which should be carefully observed, as helping to identify the substance under examination. Thus all Nitrates and Chlorates decrepitate or crackle, and produce a series of small explosions. Minerals, composed chiefly of soda or potassa, fuse readily, and run into the pores of the charcoal; those composed of barium, strontium, and calcium, emit a bright light when heated strongly. Metallic minerals, when heated, frequently deposit a coloured oxide. Thus, lead deposits a yellow oxide; others, like arsenic, volatilize, and deposit a sublimed oxide, the fumes in the case of arsenic having the peculiar odour of garlic. The colour imparted to the flame by heating the mineral should also be observed, as many metals may be thus recognized. Copper, for instance, gives a green flame; lead and antimony give a blue flame; calcium imparts a red, and strontium a crimson tinge to the flame. Sodium gives a bright yellow, and potassium a violet colour to the flame. Most metals will also give a characteristic colour to a clear borax bead, strongly heated in the blow-pipe flame. Thus iron gives a bottle-green bead, manganese a violet, and cobalt a deep blue bead; other metals simply render the bead opaque, without colouring it; and others, again, have no effect on the bead. Even without the blow-pipe some useful chemical tests may be applied. Thus all carbonates effervesce when treated with an acid, owing to the escape of carbonic acid. The behaviour of a portion of the mineral, when strongly heated by itself in a test-tube, will also generally afford some clue to its constitution. Many other characteristic blow-pipe tests will be mentioned in the Tables.

11. *Fracture*.—This term is applied to the appear-

ance presented by the mineral when broken. When the broken surfaces are respectively convex and concave, and shaped like a shell, the fracture is termed *conchoidal* (conch.). When there are few or no irregularities on the fracture-surfaces, the fracture is said to be *even*, and *uneven* if many irregularities exist. It is said to be *splintery* when there are a number of small wedge-shaped splinters projecting from the broken surfaces. When a piece of metallic tin is broken it exhibits jagged edges; such a fracture is said to be *hackly*.

12. *Localities and Mode of Occurrence*.—Some minerals occur very widely diffused, and in large quantities, such as Calcite, Gypsum, Felspar, &c.; but others occur only in minute quantities, and in a few localities. Certain minerals, though of little value themselves, are of importance as indicating the proximity of others more valuable. This portion of the subject is worthy of careful study, on account of its bearing on mining operations.

CRYSTALLOGRAPHY.

The various forms which crystals assume have been grouped under six Divisions or Systems, this classification depending on the relative position of certain imaginary lines, cutting each other in the centre of the crystal, called *axes*. The plane surfaces which bound crystals are termed *faces*. The line of junction of two faces is called an *edge*, and the angle made by the two faces which meet in the edge is called the *angle of the edge*. It is found that, however the faces may differ in development and size, this angle always remains constant in the same figure; hence this affords an accurate means of determining the nature of a crystal, and instruments, termed *goniometers*, are employed to measure this angle with the greatest precision. The union of three or more plane-angles produces what is known as a *solid angle*. When edges and angles are cut off by planes they are said to

be *truncated*, and the planes are said to *replace* them. If two planes replace an edge, the edge is said to be *bevelled*. The six systems into which crystals are divided are as follows:—I. Cubical; II. Pyramidal or Tetragonal; III. Hexagonal or Rhombohedral; IV. Rhombic or Prismatic; V. Oblique or Monoclinic; VI. Anorthic, or Doubly Oblique, or Triclinic.

Cubical System.—In this system there are three axes, all of equal length and all at right angles to each

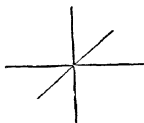


Fig. 1.

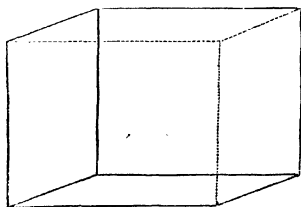


Fig. 2.—The Cube.

other. (Fig. 1.) If the extremities of each axis are cut by planes at right angles, there will be formed a cube, for the axes are of equal length. A *cube* is a figure bounded by six equal squares, and the centre of each square is penetrated by an axis. (Fig. 2.)

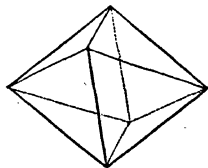


Fig. 3.—The Octahedron.

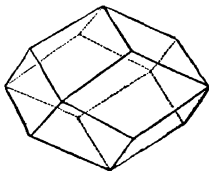


Fig. 4.—The Rhombic Dodecahedron.

If we suppose the eight solid angles of the cube to be replaced by planes, and those planes to be produced till they meet, we shall obtain an eight-sided figure termed an *octahedron*. (Fig. 3.) The octahedron

is bounded by eight equilateral triangles: it has twelve edges and six tetragonal solid angles. Each face of the octahedron cuts all three axes at an equal distance, which we may term the distance 1. The parameters (or distances between the centres and extremities of the axes), therefore, will be represented by the ratio as 1:1:1. The symbol for the octahedron is O. Any two adjacent faces are inclined to each other at an angle of $109^{\circ} 28'$. Though the cube is the simplest form in the Cubical System, it is found convenient to refer the various forms of the system, the cube included, to the octahedron. Each face of the cube cuts one axis at the distance 1, and the other two at an infinite distance, or is parallel to them. The symbol for infinity being ∞ , the ratio of the parameters becomes as $\infty:\infty:1$, and referring to the octahedron, we get the symbol $\infty O \infty$. The cube may be derived from the octahedron by placing planes on the six solid angles of the latter. Next let us suppose the twelve edges of the octahedron to be replaced by planes, and these planes to be extended till they meet. We shall obtain a twelve-sided figure, each face of which is a rhomb; hence its name, the *rhombic dodecahedron*. (Fig. 4.) Each face of the rhombic dodecahedron cuts two axes at the distance 1, and is parallel to the third axis. Hence its parameters are expressed by the ratio as

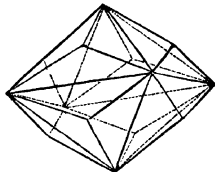


Fig. 5.—The Triakis-Octahedron.

$\infty:1:1$. Its symbol is ∞O . Any two adjacent faces of this figure are inclined to each other at an angle of

160°. The larger angle of the rhomb is $109^{\circ} 28'$, the smaller one is $70^{\circ} 32'$.

Now let us suppose that on each face of the octahedron a triangular pyramid be placed, such that its base coincides with the face of the octahedron, then we shall have a twenty-four faced figure called the *Triakis-octahedron*. (Fig. 5.) This figure is derived from the octahedron by placing planes on the edges of the latter, each plane cutting two axes at the distance 1, and the third axis at a distance m greater than 1. The ratio of the parameters becomes as $m:1:1$, and the symbol of the figure is mO . It is worthy of remark that m generally equals some whole number, commonly 2 or 3. If m equals 0, we get the octahedron from which we started, but if m equals ∞ , we obtain the rhombic dodecahedron. The *Triakis-octahedron* is therefore said to vary between these two forms.

It would occupy too much space in such a slight sketch as the present, to trace the derivation of the other primary forms of the Cubical System—viz., the *Icositetrahedron* (mOn), the *Tetrakis-hexahedron* (∞On), and the *Hexakis-octahedron* (mOn); but we must briefly notice a group of forms termed *Hemihedral* or imperfect, in contradistinction to the perfect or *Holohedral* forms described above. The *Hemihedral* forms are derived from the *Holohedral* by the suppression of half their number of faces. Thus, if each alternate face of the octahedron be enlarged so as to obliterate the other four faces, the result is a four-sided figure termed a *Tetrahedron* (Fig. 6). The *Tetrahedron*, being half the octahedron, its symbol is $\frac{O}{2}$. Other hemihedral forms are the *Pentagonal-dodecahedron* ($\frac{\infty On}{2}$) derived from the *Tetrakis-hexahedron*; the *Deltoidal-dodecahedron* ($\frac{mO}{2}$), derived from the *Triakis-octahedron*, the *Trigonal-dodecahedron* ($\frac{mOm}{2}$), derived from the *Icositetrahedron*, and the *Hexakis-tetrahedron* ($\frac{mOn}{2}$) derived from the *Hexakis-octahedron*.

Combinations.—Crystals may be found in nature occurring in almost all the above-named forms, but it

more frequently happens that they occur in forms which are combinations of these. Some of these combinations are of a comparatively simple nature, consisting of only two forms combined; but others are extremely complex, comprising as many as six or seven forms in combination, and requiring considerable

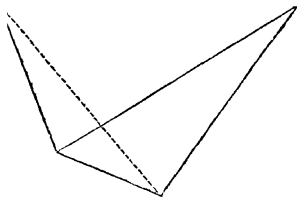


Fig. 6.—The Tetrahedron.

care in ascertaining their nature. We shall now describe some of the simpler combinations. When deriving the octahedron from the cube, it was necessary to replace the solid angles of the cube by planes, which were extended until they met and formed the octahedron. But if this process had been arrested at any intermediate stage, we should have had a form retaining some characteristics of the cube, with some of the octahedron engrafted upon it. This would therefore be called a combination of the cube and octahedron, and it would be symbolised thus— $O + ooOoo$. It will be perceived, that had the process been stopped at an early stage, the figure would have retained more of the characteristics of the cube, but if stopped at a late stage, the figure would have assumed the general appearance of an octahedron.

In Fig. 7, we see a combination of the cube and octahedron, in which the cube predominates. In Fig. 8 we have a combination of the octahedron and triakis-octahedron, the octahedron predominating. Combinations of holohedral and hemihedral forms are also common in minerals that crystallise, in the Cubical

System. Thus Boracite occurs in combinations of the cube and tetrahedron.

For purposes of study the student should provide himself with a set of models, either of cardboard or wood. In the case of combinations, much assistance will be

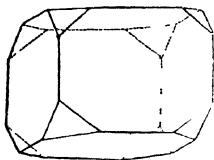


Fig 7 — Cube and Octahedron

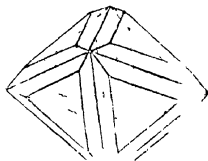


Fig 8 — Oct. and Triakis-Oct

derived from painting the faces in different colours, a certain colour being appropriated to a certain form. After a short time, the student will be able to dispense with the use of coloured models, and to use plain wooden ones; he can then proceed to the study of natural crystals; but it is by no means advisable to commence with these, as he is likely to be hindered, if not discouraged, by their imperfections. A very ingenious way of learning Crystallography is by means of what are called "nets." A net is the outline of a figure drawn on cardboard in such a manner that, when it is cut out and folded up, a perfect model of the crystalline form is obtained. Nets for constructing all the commonly occurring forms have been published by Mr. Jordan, and the learner will find these of great assistance, inasmuch as models afford a much better notion of crystals than drawings, however good, can do. The various forms of the Cubical System may be well studied in Rock-salt, Fluor-spar, Garnet, Galena, and Iron-pyrites.

Pyramidal or Tetragonal System.—In this system there are three axes, which intersect each other at right angles. Two of them are of equal length, the third differs in length. It is usual to consider this third or

unequal axis as the chief one, and to place it vertically. The fundamental figure of this system is a pyramid, each face of which cuts both horizontal axes at the distance 1, and the third axis at the distance m , which may be greater or less than 1, but which is usually $\frac{1}{2}$, 2 or 3. The ratio of the parameters is therefore as $m:1:1$, and substituting for the fixed distance 1 the symbol P , we get the symbol of the *primary pyramid* mP or P alone (Fig. 9). Now it is obvious that as the vertical axis is lengthened or shortened, we shall obtain respectively more acute or more obtuse pyramids. If the vertical axis be lengthened so that $m = \infty$ we shall no longer have a pyramid, since the faces will be parallel to the vertical axis. The result will be a *Prism*, and its symbol will be ∞P (Fig. 10). The primary pyramid and the primary prism are the chief forms of this system, and they occur in nature combined; two or three pyramids of different values often occurring in the same crystal. Besides these forms, there are others made up of double the number of faces, termed the *Ditetragonal pyramid* (mPn), and the *Ditetragonal prism* (∞Pn). The plane which closes the open ends of a prism is termed a *basal plane*, and its symbol is OP . Hence the complete symbol of a prism is $\infty P + OP$. It should also be observed, that

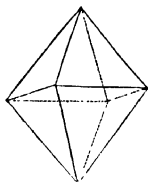


Fig. 9.—Primary Pyramid.

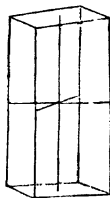


Fig. 10.—Primary Prism.

in Crystallography a pyramid is always double—that is, composed of two pyramids, placed base to base. The hemihedral forms of this system are unimportant.

Hexagonal or Rhombohedral System.—In this system

there are four axes, three of which are horizontal and equal in length; they intersect each other at an angle of 60° . The fourth one is vertical, and differs in length from the other three. The fundamental form is the *Hexagonal pyramid*, symbol mP (Fig. 11). If, as in the last system, we increase the length of the vertical axis till $m = \infty$, we obtain then a prism, termed the *Hexagonal prism*, symbol $\infty P + 0P$. The hemihedral forms of this system are very important, and consist of the *Rhombohedron* and the *Scalenohedron*. From the Rhombohedron the system derives one of its names, and it is obtained by developing each alternate face of the primary pyramid. Its symbol is $\frac{mP}{2}$ or R (Fig. 12). Well-developed crystals of this system may be seen in Calcite and Quartz.

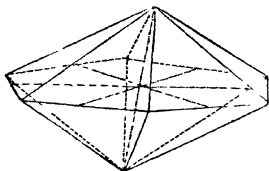


Fig. 11 —Hexagonal Pyramid.

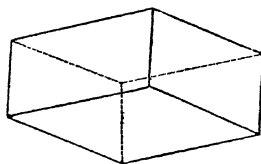


Fig. 12.—The Rhombohedron.

Rhombic, or Prismatic System.—In this system there are three axes, all intersecting each other at right angles, but all of different lengths. The fundamental figure is a pyramid called the *Rhombic Pyramid* (Fig. 13), symbol R^mP . We may have, as in the last system, a whole series of more acute or more obtuse pyramids by lengthening or shortening the principal axis. When this axis is lengthened to infinity, we get a prism called the *Rhombic Prism*, symbol $R^\infty P$.

Oblique or Monoclinic System.—In this system there are three axes, all of unequal length. Two of these axes intersect each other at an oblique angle, and the third cuts them at a right angle. One of the oblique

axes is placed vertically, consequently the crystals assume that sloping appearance from which the system derives its name. The axis which cuts the principal axis at right angles is termed the *orthodiagonal*, the other which cuts the principal axis at an oblique angle is termed the *clinodiagonal*. The fundamental

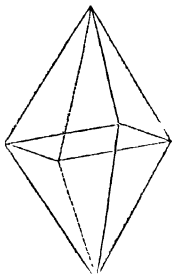


Fig. 13.—The Rhombic Pyramid.

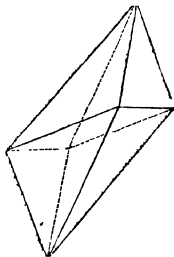


Fig. 14.—The Oblique Pyramid.

form of the system is the *Oblique Pyramid* (Fig. 14) mP, and by lengthening the chief axis to infinity we get the *Oblique Prism* ooP, the open ends of which may be closed by the basal plane OP.

A large number of minerals crystallise in this system; those that present the best crystals are *Angite* and *Felspar*.

Triclinic or Anorthic System.—There are three axes in this system, all of unequal length, and all inclined obliquely to each other; consequently the sloping appearance of the crystals is much more marked than in the last system. One axis is chosen as chief, and is placed vertically; the longest of the other two is termed the *macrodiagonal*, the shortest the *brachydiagonal*. As in the *Oblique System*, a series of pyramids, more or less acute, is produced by altering the length of the principal axis. This system is comparatively of very little importance, as so few minerals crystallise in forms belonging to it. The

mineral which presents the best examples of crystals is sulphate of copper.

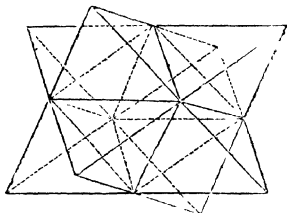


Fig. 15.—Macle or twin-crystal, composed of two Tetrahedrons.

The term *Cleavage* has before been explained, but its application could not be described before the forms of crystals had been understood by the student. It is now necessary to state that in every crystal cleavage takes place parallel to some form of the system to which the crystal belongs; thus, the cleavage of the Diamond is parallel to the faces of the octahedron, and it is said to have an octahedral cleavage. Fluor-spar, though generally occurring in modifications of the cube, also possesses octahedral cleavage.

Calcite occurs crystallised in the hexagonal system, and its cleavage is rhombohedral, or parallel to the faces of the rhombohedron. The cleavage of Blende is rhombic-dodecahedral, that of Felspar is brachy-diagonal, and that of Topaz is parallel to the basal plane of the prism.

When the cleavage is well marked, and the mineral splits easily, developing perfect forms, it is said to be *perfect* (per.). When the cleavage is less marked, it is said to be *imperfect* (imper.). Mica offers a good example of cleavage, as it splits up readily in excessively thin leaves. The cleavage of Mica, Gypsum, and a few others, is distinguished by the term *highly perfect*.

Fluor-spar and Barytes exhibit *very perfect* cleavage.

The Topaz, Angite, and Felspar exhibit *perfect* cleavage. In most minerals—as, for example, the Garnet—the cleavage is *imperfect*, and some—as Quartz—do not exhibit this property at all.

IRREGULARITIES OF CRYSTALS.

It should be remembered that perfect crystals are very rare things in nature ; very commonly only one end of a crystal is visible, the other being attached to the rock in which the crystal is imbedded. Many circumstances operate to prevent perfect development of all the faces of a crystal, amongst which may be mentioned want of space, absence of water, and want of sufficient time in cooling from a state of fusion.

Nevertheless, when only two or three faces of a crystal are perceptible, the mineralogist is able to recognize the nature of the form, and to reproduce the whole in his imagination. This is in accordance with the very important law that “every axis of a crystal enjoins similar and parallel faces.”

It sometimes happens that combinations occur made up, not of two different forms, but of two similar forms, one being reversed in position with respect to the other. Such crystals are termed *Macles* or *Hemitropes*, or Twin-crystals. Thus combinations of two Tetrahedrons may occur, one passing at right angles through the other. (Fig. 15.) Examples of Twin-crystals may be seen in Fahlerz, or Grey Copper ore, and in Sulphide of Manganese.

Pseudomorphism.—When a mineral crystallises in forms not proper to the system to which it belongs, it is called a *Pseudomorph*. Thus it sometimes happens that Quartz is found crystallised in cubes, like those presented by Fluor-spar ; whereas we know that Quartz belongs to the Hexagonal System. In such a case we perceive that the original crystals of Fluor-spar have been gradually encrusted by Quartz ; and the Fluor-spar having been subsequently washed

away, hollow cubes are left, consisting of Quartz. Frequently, also, these hollow cubes have been filled up by some other substance, so that the exterior and interior really consist of different minerals. In the same way Tetrahedrite is found encrusted with Copper-pyrites, and the occurrence of Quartz encrusting rhombohedrons of Calc-spar may also be called pseudomorphic, though both minerals belong to the same system.

Pseudomorphic minerals are very likely to deceive the observer at a first glance, but the tests of hardness and specific gravity are generally sufficient to reveal the true character of the mineral.

Dimorphism and *Trimorphism*.—Sometimes two minerals, possessing the same chemical composition, will crystallise in different forms; thus Calcite and Arragonite both consist of carbonate of lime, but the former belongs to the Hexagonal, the latter to the Rhombic System. Again, Iron-pyrites occurs in the Cubical System; and the same substance, under the name of Marcasite, occurs in the Rhombic System. Carbon also occurs both as the Diamond and Graphite. Such substances are said to be *Dimorphic*. An example of a *Trimorphic* mineral occurs in Anatase, Rutile, and Brookite. All these substances consist of oxide of Titanium, yet the first and second occur in different forms of the Pyramidal, the third in the Prismatic System.

Isomorphism.—This term is used to express the property shown by some minerals when two or more crystallise in the same form. In the Cubical System Isomorphism is common, the following minerals all crystallising in forms which are identical or nearly so: Galena, Rock-salt, Fluor-spar, Iron-pyrites.

Double Refraction and *Polarization*.—It has already been mentioned that certain minerals exhibit the property of double refraction. In most crystals exhibiting this property there is *one* direction in which the extraordinary ray coincides with the ordinary ray,

and therefore no double refraction ensues. Such crystals are termed *Monoaxial* or *Uniaxial* crystals; but in other doubly refracting minerals there are *two* directions in which double refraction is impossible, and these are termed *Biaxial* crystals. It has been found that all crystals belonging to the Pyramidal and Hexagonal Systems are uniaxial, while crystals of the Prismatic, Oblique, and Anorthic Systems are biaxial. As has been before mentioned, no double refraction is observed in crystals of the Cubical System. Closely connected with the phenomena of refraction are those of polarization. By polarization is meant the peculiar property which certain crystals have of changing the nature of the light transmitted through them, or of stopping it altogether. The mineral which exhibits polarization in greatest perfection is Tourmaline. For further details respecting double refraction and polarization the student is referred to a treatise on Optics, to which subject they properly belong.

Electrical and Magnetic Properties of Crystals.—Some minerals exhibit electrical properties when simply rubbed—as, for example, Amber; others require heating, as the Topaz. Electricity may be developed in the Diamond, in Tourmaline, Fluor-spar, Blende, Calamine, and a few others. Minerals that develop electricity only by heating are termed *Pyro-electric*.

The only two minerals that exhibit powerful magnetic properties are Meteoric Iron and Magnetic Oxide of Iron. Others, however, affect the needle to a slight extent, owing, probably, to their containing small quantities of the magnetic oxide. Thus Franklinite, Specular Iron, Chrome Iron, Platinum, Basalt, and Serpentine, all exhibit, more or less, magnetic properties.

In the following Tables the Crystalline Systems are indicated by the Roman numerals only (see page 14). The common forms in which any mineral occurs are written in full; the rarer forms are written only in

symbols, which the student will easily comprehend by referring to the section on Crystallography. Owing to the limited space, it has been found necessary to abbreviate several of the technical terms, and therefore, in explaining those terms in the foregoing pages, the abbreviations have been attached. As regards the chemical notation, the ordinary mineralogical symbols have been retained, chiefly on account of the convenience they offer for abbreviating long formulæ. Thus a dot is substituted for Oxygen, and a dash for Sulphur. When a small figure is placed after any symbol standing alone, it affects only the symbol to which it is attached; but when a small figure is placed after symbols enclosed in curved brackets, it affects all symbols contained within the brackets. Thus in the formula, $\ddot{\text{Al}}_2(\dot{\text{H}})_3$, the figure 2 applies to Al only, and does not affect the oxygen; on the other hand, the figure 3 affects both the hydrogen and oxygen contained within the brackets. When a large figure is placed before any formula, it affects the whole of the symbols within that formula as far as the next plus sign; thus in the formula, $2\ddot{\text{Al}}_2(\dot{\text{Si}})_3 + (\dot{\text{N}}\text{a})_2(\dot{\text{Si}})_3$, the large figure 2 doubles all symbols, including those within brackets, as far as the plus sign; making two equivalents of Sesquioxide of Alumina, and six equivalents of Silica, but it does not affect the symbols beyond the plus sign. Angular brackets ($\langle \rangle$) are used to signify that *all* the oxides contained within them are not essential to the composition of the mineral, but that different specimens vary in this respect. A list of chemical symbols is here appended:—

Aluminium	Al.	Manganese	Mn.
Antimony.....	Sb.	Mercury	Hg.
Arsenic.....	As.	Molybdenum	Mo.
Barium.....	Ba.	Nickel	Ni.
Bismuth	Bi.	Nitrogen	N.
Boron	B.	Oxygen	O. (.)
Bromine	Br.	Palladium	Pd.
Cadmium	Cd.	Phosphorus	P.

Calcium	Ca.	Platinum	Pt.
Carbon	C.	Potassium	K.
Chlorine	Cl.	Selenium	Se.
Cobalt	Co.	Silver	Ag.
Chromium	Cr.	Silicon	Si.
Copper	Cu.	Sodium	Na.
Fluorine	F.	Strontium	Sr.
Glucinum	Gl.	Sulphur	S. (')
Gold	Au.	Tellurium	Te.
Hydrogen	H.	Tin	Sn.
Iron	Fe.	Titanium	Ti.
Iodine	I.	Tungsten	W.
Lead	Pb.	Uranium	U.
Lithium	Li.	Zinc	Zn.
Magnesium	Mg.	Zirconium	Zr.

Classification of Minerals.—This has always been a subject of discussion; and when we consider the variety of substances included in the mineral kingdom, and the divergencies of character which they display, we shall perceive that it is no easy task to frame a classification which shall be a definite and accurate expression of facts. Some writers, following the example of Mohs, consider that external characters, especially crystalline form, should be the basis of classification; and they have arranged minerals into groups according to this principle. Others, holding with Berzelius that Mineralogy is a branch of Chemistry, have determined to consider chemical composition as the proper foundation of a system of classification. According to this plan, the Silicates form one group, the Sulphides another, the Native Metals another, and so on. Both these systems, if rigidly carried out, involve great disadvantages, the chief of which is the grouping together of substances dissimilar in all characters but that one on which the system is founded. It is, however, possible to frame a classification in which chemical composition shall be the principal element, without altogether adhering to the plan proposed by Berzelius. Such a system has been adopted by Dr. Dana in his elaborate treatise on Mineralogy, and it is employed in the following

Tables. On this system all the compounds of the same element are, as far as possible, classed together, and the compounds of kindred elements are arranged under one group. This plan offers an advantage to the student, as it is found, by a coincidence so constant as almost to amount to a law, that the hardness and specific gravity of compounds of the same element, and of those of kindred elements, vary only within small limits. Hence, at the head of each group, a hardness and specific gravity are given, which include those properties for all the minerals contained in that group. Should the hardness or specific gravity of any mineral in the group be not included in those limits, the mineral is marked with an asterisk. If neither property be included within the limits, the mineral is marked with a double asterisk.

TABLES.

CLASS I., including the GASES, and

30

CLASS III., CARBON and its Com-

NAME.	Crystalline Form and Cleavage.	Hardness.	Specific Gravity.	Chemical Composition.
DIAMOND.	I. In oct. rhombic dodec. and hexakis-oct. with curved faces, combinations of O and mOm cl. parallel to oct. highly perfect.	10	3.48-3.5	Pure carbon.
GRAPHITE (Plumbago).	III. Rarely in crystals, usually foliated massive or gran. compact.	1-2	2.09	Carbon 90 to 95 per cent., the rest Fe Si, &c.
COAL— Varieties { Anthracite. Common Coal. Cannel. Lignite.	Occurs in regular beds or strata, massive. Structure laminated, parallel to lines of bedding.	1-2.5	1.2-1.7	Carbon. per cent. Anthracite 90-96 Newcastle, 85. Cannel, 80-85 Lignite, 65. Also H and O.
BITUMEN (Asphalt. Naptha)	Amorphous when solid, sometimes liquid as naptha.	0-2	0.8-1.1 Naptha. 0.7-0.84	CH ₂
MBER.	Amorphous, occurs in irregular lumps.	2-2.5	1.18	C ₁₀ H ₈ O.

ASS II., including WATER, are omitted.

inds, and CLASS IV., SULPHUR.

31

Colour and Streak.	Lustre, &c., and State of Aggregation.	Tests. Blow- pipe characters, &c.	Localities, and Mode of Occurrence.
Colourless, white, blue, rarely black, strong- refractive.	Admt. transp. ex- hibits vit. electricity, and is phos- phorescent. Very brittle.	Burns at a high tempera- ture forming C. Its hard- ness and cleavage are very charac- teristic.	In India, it occurs in quartzose conglomerate; in Brazil, in laminated gran- quartz. Also found in allu- vial washings. Borneo, Su- matra, The Urals, Cape of Good Hope.
Black and dish-grey to black. S.	Met. Lamæ thin and flexi- ble.	Infusible, and not acted upon by acids. Sk. is charac- teristic.	Occurs in metamorphic rocks, gneiss, mica-schist, and gran. limestone; also in granite. Borrowdale (Cum- berland), Ceylon, Bohemia, Canada.
.. brown black. Sk. or greenish- c. An- site does soil the rs.	Anthracite, semi-met., sometimes iridescent. Common coal res. Cannel no lustre or res. Brittle to sectile.	Bituminous kinds burn with bright flame, and bi- tuminous odour. Cannel burns easily. Anthracite takes fire with difficulty.	South Wales, Staffordshire, Yorkshire, Northumberland, Kilkenny, King's County; also in Scotland, France, Belgium, United States. Oc- curs in formations, consisting of alternating beds of coal, sandstone, and shale.
Other yel- h. When called oleum. shalt n to c. low, le- - yellow, nish yel-	Solid varie- ties res. Fluid varieties nearly colour- less and transp.	All varieties burn readily with flame and smoke, and bitumin- ous odour.	Solid bitumen occurs in the Dead Sea. Lakes of asphaltum occur in Trinidad. Naphtha occurs in Persia, China, and Birmah. Petro- leum springs occur in Canada and Pennsylvania.
	Res. greasy, transp. to opaque. Is elec- trified by fric- tion.	Burns with a yellow flame and aromatic odour.	Occurs sometimes in lignite. Found on the coasts of the Black and Adriatic Seas, and on the coast of Finland, Spain, Syracuse.

NAME.	Crystalline Form and Cleavage.	Hardness.	Specific Gravity.	Chemical Composition.
SULPHUR.	IV. In pyrds of various values. Forms acic. crystals when slowly cooled.	1·5-2·5	2·07	S

CLASS V., Compounds of the ALKALIES and EARTHS,

			GROUP I.—SALTS OF NH ₄	
AL-AMMONIAC.	I. In oct. also as an efflorescence and incrusting.	1·5	1·52	NH ₄ Cl.
ALTPETRE (Nitre).	IV. In prisms ooPoo; also incrusting, and in acic. crystals, cl. indist.	2	1·9	$\begin{array}{c} \cdot \cdot \cdot \\ \text{K} \cdot \text{N} \cdot \\ \cdot \cdot \cdot \end{array}$
LAUBER SALT Mirabilite Thénardite.	V. In oblique prisms; also as an efflorescent crust.	1·5-2	1·4	$\begin{array}{c} \cdot \cdot \cdot \\ \text{Na} \cdot \text{S} + 10 \text{ H} \cdot \\ \cdot \cdot \cdot \end{array}$ (Thénardite anhydrous).
TRATE OF SODA (Chili Saltpetre).	III. In obtuse rhombohedrons; also incrusting.	1·5-2	2·1	$\begin{array}{c} \cdot \cdot \cdot \\ \text{Na} \cdot \text{N} \cdot \\ \cdot \cdot \cdot \end{array}$
TEON.	V. In oblique prisms.	1-1·5	1·4	$\begin{array}{c} \cdot \cdot \cdot \\ \text{Na} \cdot \text{C} \cdot \\ \cdot \cdot \cdot \end{array}$

our and reak.	Lustre, &c., and State of Aggregation.	Tests. Blow- pipe characters, &c.	Localities, and Mode of Occurrence.
low, e-yel- Sk. yel-	Res. transpt. to translt. Brittle.	Burns with a blue flame and sulphur- ous odour forming S.	Occurs as an efflorescence in volcanic districts, Vesu- vius, Sicily. Occurs also in Hungary, Spain, Teneriffe, and Java.

l of their **METALS** (excluding Silicates).

— Na. H = 1 — 2. G = 1.4 — 2.			
ite or d brown- yellow- Taste	Translt. to ope. Soluble in water.	Gives off NH ₃ when heated with quicklime.	Occurs in volcanic regions, <i>e.g.</i> , Etna, Vesuvius, the Sandwich Islands. Also about ignited coal seams.
ite or sh. cooling aline.	Translt. Soluble in water.	Decrepitates strongly be- fore the blow- pipe.	Found in caverns in the United States; also as an efflorescence in the East Indies, and in France, Hun- gary, Spain, and Egypt.
ite or vish Taste g, feebly and	Translt. to ope. Loses H readily. More soluble in cold than in hot H.	Gives a yellow colour to the flame. Fusible.	Found in saline lakes near Madrid; also with NaCl in the Eastern Alps.
te, often sh or vish. cooling.	Translt. Very deli- quescent.	Decrepitates like nitre, and burns with a yellow flame.	Occurs as an efflorescence in Atacama (Peru) and in Chili.
ite, also vish. alkaline.	Transpt. to translt. Ef- floresces on exposure to the air.	Very soluble in H. Effer- vesces strongly with Nitric Acid.	Found in Hungary and Bohemia, and in solution in the lakes of Egypt.

NAME	Crystalline Form and Cleavage.	Hardness.	Specific Gravity.	Chemical Composition.
COMMON SALT.	I. In cubes, and combinations of cube and oct., and in hollow cup-shaped crystals.	2	2-2.5	Na Cl.
BOBAX (Tincal).	V. mPoo cl. parallel to basal plane OP.	2-2.5	1.7	Na (B̄)₂
GROUP II.—SALTS OF				
BARYTES (Heavy-spar).	IV. In flat prisms ooP + P̄oo + P̄oo + OP; also in tab. crystals. Col. gran. fib. coarse lam. and compact.	2.5-3.4	4.3-4.8	Ba S̄
WITHERITE.	IV. ooP + Poo + 2 P̄oo.—cl. imper.; also in glob. and bot. forms. Massive, fib. and gran.	3-4	4.3	Ba C̄
CELESTINE.	IV. ooP + P̄oo + OP.—cl. parallel to brachy pinacoid planes, col. and fib.	3-3.5	3.9-4	Sr S̄.

Colour and Streak.	Lustre, &c., and State of Aggregation	Tests. Blow-pipe characters, &c.	Localities, and Mode of Occurrence.
White, grey, brown, rose-stone. Teste saline.	Transpt. to op. Equally soluble in hot and cold water. Insoluble in pure alcohol.	Decrepitates when heated, and tinges the flame golden yellow.	Occurs in beds in the new red marl in Cheshire. Found in Poland in the Tertiary rocks. Occurs also in the Pyrenees, at Cardona (Spain), Salzburg (Austria), Bex (Switzerland), and in Hungary.
White. Teste sweetish saline.	Vit. transpt. Decomposes on exposure to the air.	Swells up when heated becomes op. white, and fuses to vit. bead.	Occurs in salt lakes in Thibet and Tuscany; also in California.
1—Sr—H=3—4 G 3·6—4·8.			
White, aged with bluish, red, or brown. Sk. white.	Vit. transpt. or translt. Brittle.	Decrepitates and fuses with difficulty. Insol. in H Cl.	Occurs in the mountain limestone with the ores of metals, especially Pb in Derbyshire, the South of Ireland, Cumberland, and in Bohemian mines.
Massive varieties are bluish or greyish white. Crystals are white. Sky-blue or white.	Res. Crystals are transpt., massive varieties translt. Brittle.	Decrepitates and fuses to a translt. bead, which is op. when cool. Sol. in H Cl.	Found at Alston Moor (Cumberland), and near Hexham (Northumberland); also in Lancashire.
	Vit. or pearly, transpt. to translt. Very brittle.	Decrepitates and fuses to a white bead. Phosphoresces when heated.	Occurs in masses of sulphur at Girgenti (Sicily); also in calc-spar in Switzerland, and in geodes near Bristol.

NAME.	Crystalline Form and Cleavage.	Hardness.	Specific Gravity.	Chemical Composition.
STREONTIANITE.	IV. Seldom in dist. crystals, usually in bundles of minute fibres; also glob. and gran.	3·5-4	3·7	$\dot{\text{Sr}} \ddot{\text{C}}$.
GROUP III.— $\dot{\text{Ca}}$ —				
*GYPSUM.	V. ooP + (P) + (ooPoo), cl. clinodiagonal very per. Often in twin crystals. Also in lam. and fib. masses, gran. and compact.	1·5-2	2-3	$\dot{\text{Ca}} \ddot{\text{S}}$ and 2 $\dot{\text{H}}$.
ANHYDRITE.	IV. Occurs also fib. lam. and gran.	2·5-3·5	2·9-3	$\dot{\text{Ca}} \ddot{\text{S}}$
CALCITE— Varieties. { Calcareous spar. Chalk. Limestone Oolite. Marble. Iceland Spar	III. In rhombohedrons, and hexagonal prisms. OR + ooR, also 2 R + R cl. rhombohedral per. Also lam. gran. and compact. IV. In combinations of prisms and pyramids. ooPoo + ooP + Poo cl. brachydiagonal dist. Also col. and fib.	3	2·5-2·8	$\dot{\text{Ca}} \ddot{\text{C}}$.
ARAGONITE.		3·5-4	2·93	$\dot{\text{Ca}} \ddot{\text{C}}$.

Colour and Streak.	Lustre, &c., and State of Aggregation.	Tests. Blow-pipe characters, &c.	Localities, and Mode of Occurrence.
Pale green, white, yellow, and yellowish brown.	Vit. or res. transpt. to translt. Brittle. Scarcely soluble in H.	Fuses at the edges, and effervesces with acids. Salts of Sr give a crimson tint to the flame.	Occurs with the ores of Pb and Ag, also with calc-spar, obtained from Strontian (Argyleshire).
[g. H=3 — 4 G=2·3 — 3·2.			
White, also yellow, red, and brownish.	Dull vit., some faces pearly. Translt. to ope. Lamæ flexible, inelastic.	When heated becomes white and ope. and falls to powder without fusion. Not acted upon by acids.	Found with Na Cl in the Trias of Derbyshire. In nodules in clay at Volterra; also in mineral veins, and in old mines, as a product of decomposition.
White, aged with grey, red, or blue.	Pearly. Transpt. to subtranslt.	When heated it whitens, but does not exfoliate like gypsum.	Found in the salt-mines of Bex (Switzerland), also at Halle (Tyrol), and in Austria.
White, may be tinged with yellow or violet.	Vit. transpt. Some kinds dull and ope. Brittle.	Infusible, but becomes luminous. Effervesces with acids. Some varieties phosphoresce.	Doubly-refracting spar from Iceland, marble from Carrara. Calcite occurs in Pb veins and in Ag mines. Chalk, limestone, and oolite form extensive beds in England and the Continent.
White, or tinged with grey, yellow, green, or violet.	Vit. transpt. to translt.	Effervesces with acids. Falls to powder when heated. Phosphorescent.	Found in Arragon, and at Carlsbad; also in the hot springs of Tivoli. Generally accompanies gypsum. Occurs also in basalt and other rocks.

NAME.	Crystalline Form and Cleavage.	Hardness.	Specific Gravity.	Chemical Composition.
DOLOMITE — Var. { Pearl-Spar. Bitter-Spar, &c.	III. In rhombohedrons with curved faces, also gran. and massive.	3·5–4	2·8–2·9	$\dot{\text{Ca}} \ddot{\text{C}} \dot{\text{Mg}} \ddot{\text{C}}.$
*APATITE.	III. In hexagonal prisms with OP cl. prismatic and basal imper. Also massive mam. and fib.	5	3·3·2	$(\dot{\text{Ca}})_3 \ddot{\ddot{\text{P}}}$
FLUOR SPAR (Derbyshire-spar).	I. In cubes and combinations. ooOoo + oo On, also ooOoo + m On cl. oct. per., often compact.	4	3·1	Ca F.
**EPSOM SALTS.	IV. In prisms cl. brachy-diagonal. Also in fib. crusts, and in bot. masses.	2–2·5	1·7	$\dot{\text{Mg}} \ddot{\ddot{\text{S}}} + 7 \dot{\text{H}}.$
MAGNESITE.	III. Ren. or massive, cl. rhombohedral per. Often in fib. plates, also gran. or compact.	3–4·5	2·83	$\dot{\text{Mg}} \ddot{\text{C}}.$
*BRUCITE.	III. OR + ooR cl. basal very per. Also in foliated masses.	1·5	2·35	$\dot{\text{Mg}} \dot{\text{H}}.$

Colour and Streak.	Lustre, &c., and State of Aggregation.	Tests Blow-pipe characters, &c.	Localities, and Mode of Occurrence.
White, tinged with yellow, red, or brown.	Vit. or slightly pearly. Sub-transpt. to translt. Brittle.	Infusible. Effervesces with acids. <i>on bottle</i>	As magnesian limestone it forms extensive beds in Durham and Derbyshire.
White, pale blue, pink, or green; also yellowish-green and bluish green.	Res. or oily. Small crystals transpt., large ones ope. Brittle.	Dissolves in nitric acid without effervescence. Infusible. Sometimes phosphorescent.	Found in the Alps and in Bohemia, associated with Sn ores; also in Norway. Occurs in gran. masses in Canada, also in Tyrol and Estremadura (Spain).
White, light green, purple, or yellow. Massive varieties often banded.	Vit. transpt. to translt. Brittle.	Decrepitates and fuses to an enamel. Phosphorescent.	Derbyshire, Cornwall, Saxony. Occurs generally in gneiss, mica-slate, and limestone. Found associated with galena.
White. Taste bitter and saline.	Vit., sometimes earthy. Very soluble.	Deliquesces when heated. Does not effervesce with acids.	Found in caverns and in mineral springs, Epsom, Sedlitz, Arragon; also in Chili and in South Africa.
White, yellowish, greyish-white, and brown.	Vit. Fibrous varieties silky. Transpt. to ope.	Infusible. Dissolves slowly, with slight effervescence in nitric acid.	Usually occurs in magnesian rocks, especially Serpentine.
Colourless, grey or greenish.	Pearly. Translt. Sectile. Lamæ. flexible, but inelastic.	Infusible, becomes ope. and friable. Soluble in acids, without effervescence	Found in Serpentine in the Shetland Islands.

NAME.	Crystalline Form and Cleavage.	Hardness.	Specific Gravity.	Chemical Composition.
*BORACITE.	I. In small crystals ooOoo + ooO + $\frac{O}{2}$ cl. Oct. very imper.	7	2.9	$(\dot{M}g)_3 (\ddot{B})_4$
GROUP IV.— $\ddot{Al}_2 H$				
*ALUM.	I. In oct., also with ooOoo. cl. oct. imper.; also occurs as an efflo- rescence.	2-2.5	1.75	$\ddot{Al}_2 (\ddot{S})_3 \dot{K} \ddot{S}$ + 24 H.
ALUNITE (Alum-stone).	III. In rhombo- hedrons, cl. basal per.; also massive.	4	2.5-2.7	$(\ddot{Al}_2 \ddot{S})_3 \dot{K} \ddot{S}$ + 6 H.
*WAVELLITE.	IV. Usually in small hemispheres, having a rad struc- ture. Cl. ooP rather per.	3.5-4	2.3-2.5	$\ddot{Al}_2 (\ddot{P})_3 +$ 12 H
*TURQUOISE (Calaite).	Occurs in ope. ren. masses with- out cl.	6	2.6-3	$(\ddot{Al}_2)_2 \ddot{P} + 5 H.$
CRYOLITE.	Usually massive cl. basal per.	2-2-2.5	2.9	3 Na F + $Al_2 F_3$
*LAZULITE.	V. Crystals are prismatic or tab. in form. Usually massive.	5-6	3.05	$(\ddot{Al}_2)_2 \ddot{P} + (\dot{M}g$ $Fe)_3 \ddot{P}.$
CORUNDUM— Var. { Sapphire. Ruby. Emerv.	IV. In prms. capped with pyrds.	9	3.9-4	\ddot{Al}_2

Colour and Streak.	Lustre, &c., and State of Aggregation.	Tests. Blow-pipe characters, &c.	Localities, and Mode of Occurrence.
White or greyish. Crystals exhibit polar electricity.	Vit. Crystals are transl.	Intumesces, and forms a vit. bead, yellow when hot, white and ope. when cold.	Occurs with Na Cl and gypsum in Saxony and Holstein.
= 2.5 — 4. G = 2.3 — 3.			
White. Sweetish-as-trigent taste.	Sometimes in fib. masses with silky lustre.	Loses H of crystallization, froths up and forms a white, porous mass.	Native alum is produced by the action of the $\ddot{H} \ddot{S}$ of the volcano, upon the \ddot{K} and \ddot{Al}_2 in the rocks. Obtained artificially by the decomposition of aluminous shales.
White, greyish, or reddish.	Vit. or pearly. Transp. to transl.	Decrepitates. Infusible alone and with Soda.	Found in rocks of volcanic origin at Tolfra, near Rome, and in Hungary.
White, pale grey, yellowish, and brownish.	Pearly or res. Transl.	Whitens when heated, but does not fuse.	Found in porphyry in Cornwall, in clay-slate in Devonshire. Also found in Bohemia and Bavaria.
Pale green to fine blue.	Waxy or res. Nearly ope.	Infusible. Treated with HCl. loses colour.	Occurs in veins that traverse the mountains near Michabourg (Persia); also obtained from Mount Sinai.
Snow-white.	Subvit. or pearly. Transl. Brittle.	Melts in the flame of a candle.	Found in Greenland.
Fine azure blue.	Vit. Nearly ope. Brittle.	Intumesces without fusion when heated.	Occurs in veins in clay-slate at Salzburg; and in the Austrian Alps.
Sapphire, fine blue. Ruby, crimson.	Vit. Transp. Emery, dark iron-grey.	Infusible. Insol. in acids.	Found in river-gravel in Ceylon, Pegu, Bohemia; also in Piedmont and Sweden. Emery from Smyrna.

NAME.	Crystalline Form and Cleavage.	Hardness.	Specific Gravity.	Chemical Composition.
**DIASPORE.	IV. In broad prisms. Usually foliated or rad.	6-7	3.4	$\ddot{\text{Al}}_2 + \dot{\text{H}}$.

CLASS VI., SILICA and SILICATES

		GROUP I.—SILICA AND		
Varieties.	*QUARTZ— { Rock-crystal. Amethyst. Chalcedony. Jasper. Opal. Onyx. Agate. Flint. Chryso-prase. Avanturine.	III. In hexagonal prisms, transversely striated, capped with hexagonal pyramids. No cl. Also occurs in coarse radial forms, coarse and fine gran. and compact.	7 (Opal) 5.5-6.5	$\ddot{\text{Si}}$ Some varieties contain Oxide of Iron, Clay, Chlorite, &c. Crystals often penetrated by rutile, actinolite, &c. Opal contains H.
	WOLLASTONITE (Tabular-Spar).	V. Rarely crystallized cl. OP and oop imper. Usually fol. or col.	4-5	2.7-2.9
DATHOLITE. <i>2</i>	V. In small and complicated crystals, cl. orthodihedral very imper.	5-5.5	2.9-3	$\dot{\text{Ca}} \ddot{\text{Si}}, \dot{\text{Ca}} \ddot{\text{B}} + \dot{\text{H}}$.

Colour and Streak.	Lustre, &c., and State of Aggregation	Tests. Blow-pipe characters, &c.	Localities, and Mode of Occurrence.
Grey, green, or hair-brown.	Vit. or pearly. Subtranspt. Brittle. Trichromatic.	Decrepitates with violence when heated.	Occurs in the Urals in gran. limestone.

of the ALKALIES and EARTHS.

SILICATES OF LIME. H = 4—5·5 G = 2·2—3.

Rock-crystal, colourless. Amethyst, bluish-violet. Chalcedony, pale blue or grey. Agate, various in stripes. Onyx, bands of black and white. Jasper, dull red or yellow.	Rock-crystal and Amethyst vit. and transpt. Chalcedony, Agate, &c., subvit. and translt. Opal subvit., with a play of colours and internal reflections of white, green, yellow, brown, grey.	Infusible alone, fusible with Soda. Not acted upon by acids. The hardness and absence of cleavage are characteristic tests.	Silica is the principal ingredient in sandstones. Quartz forms a part of granite, and occurs in veins in metalliferous districts. Amethyst occurs in slate quarries, and in the Snowden Mountains. Opal from Mexico. Jasper from the Hartz. Chalcedony from Faroe Islands. Agate occurs in amygdaloids.
Pale grey, may be tinged with yellow.	Vit., inclining to pearly. Translt., rarely subtranspt. Brittle.	Fuses with difficulty to a subtranspt. colourless glass. Decomposed by HCl.	Occurs in rocks that have undergone metamorphism, also occasionally in basalt and lava, as at Edinburgh.
Greyish, greenish, or reddish.	Vit. Transpt. to translt.	When heated becomes op., fuses to a vit. bead, and colours the flame green.	Occurs in amygdaloid and gneiss. Scotland, Tyrol, and Norway; also with Ag ores in the Hartz.

NAME.	Crystalline Form and Cleavage.	Hardness.	Specific Gravity.	Chemical Composition.
OKENITE.	IV. OP + ooPoo + OP, also occurs in fib. masses.	4.5	2.2-2.3	$\dot{\text{Ca}} (\ddot{\text{Si}})_3 + \dot{\text{H}}$
PECTOLITE.	V. Occurs in fib. aggregates, also spheroidal and col.	4.5	2.6	$8 \dot{\text{Ca}} \ddot{\text{Si}} + (\dot{\text{Na}})_2 (\ddot{\text{Si}})_3 + 3 \dot{\text{H}}$
GROUP II.—HYDROUS SILICATES OF				
TALC.	IV. In rhombic or six-sided tables. Usually in foliated masses, cl. basal very per.	1-1.5	2.5-2.9	$(\dot{\text{Mg}})_4 (\ddot{\text{Si}})_5 + \dot{\text{H}}$
STREATITE— Var. { Soapstone. French Chalk.	Massive. In pseudomorphs of Quartz.	1.5	2.7	$\dot{\text{Mg}} \ddot{\text{Si}} + (\dot{\text{Mg}})_2 (\ddot{\text{Si}})_3$
CHLORITE.	III. OP + ooP and OP+P, also in foliated masses, cl. parallel to OP.	1.5	2.6-2.8	$3 \dot{\text{Mg}} \ddot{\text{Si}} + (\dot{\text{Mg}})_2 \ddot{\text{Al}}_2 + \dot{\text{H}}$
SERPENTINE— Var. { Picrolite. Marmolite.	Rarely in crystals, usually massive.	3-4	2.5-2.6	$(\dot{\text{Mg}})_3 (\ddot{\text{Si}})_2 + 2 \dot{\text{H}}$

Colour and Streak.	Lustre, &c., and State of Aggregation	Tests. Blow-pipe characters, &c.	Localities, and Mode of Occurrence.
White, tinged with yellow or blue. Colourless or whitish.	Pearly or vit. Subtranspt. or transl. Weak—pearly. Very tough. Phosphorescent when quickly broken.	Fuses at the edges. Gelatinises easily in HCl. Fusible to a transparent white glass.	Found in Greenland and the Faroe Islands. Occurs in Renfrewshire, at the Castle Hill, Edinburgh, and in the Tyrol.
MAGNESIA. H = 1·5 — 4 G = 2·5 — 3.			
Pale green, deep green, or greyish.	Pearly when crystalline, res. if massive. Translt. Greasy to the touch.	Lamæ, flexible, not elastic. When heated it loses colour, and emits light, but does not fuse.	Occurs in Switzerland and the Tyrol. It is constituent of Protogine.
Grey or greyish-green, also red or yellow. Olive green. Lamæ, not elastic.	Pearly. Unc- tuous or soapy to the touch. Pearly. Subtranslt. to ope.	Melts in fine splinters to a white enamel. Fuses at the edges only. Yields H when heated in a glass tube.	It is common in veins of Tin ore in Bohemia. Also found in Sweden and Bavaria. Found as a constituent of metamorphic rock in various countries
Various shades of green and red.	Res. or waxy. Translt. to ope. Sectile.	Becomes brownish-red on heating and loses H. Fuses at the edges.	Occurs as a constituent of the rock Serpentine, also disseminated in gran. limestone.

NAME.	Crystalline Form and Cleavage.	Hardness.	Specific Gravity.	Chemical Composition.
*NEPHRITE (Jade).	Amorphous. Massive and compact.	6·5-7·5	2·9-3	$2 \dot{\text{Mg}}(\ddot{\text{Si}}) + \dot{\text{Ca}} \ddot{\text{Si}} + \dot{\text{H}}.$
MEERSCHAUM.	Amorphous. In nodules of irregular shape.	2	2·6-3·4	$2 (\dot{\text{Mg}})_2 (\ddot{\text{Si}})_3 + 3 \dot{\text{H}}.$
SCHILLER-SPAR.	VI. Massive, with foliated structure.	3·5-4	2·5-2·7	$\dot{\text{Mg}} [\dot{\text{Ca}} \dot{\text{Fe}}] \ddot{\text{Si}} [\ddot{\text{Al}}_2 \ddot{\text{Fe}}_2 \ddot{\text{G}}_2] + \dot{\text{H}}$

GROUP III.—ANHYDROUS SILICATES OF

AUGITE (Pyroxene)— Diopside. Sahlite. Fassaite. Coccolite. Diallage. Hypers- thene. Varieties.	V. In thick prisms. ooP + ooPoo + P + (ooPoo), also ooPoo + (ooPoo) + Poo + ooP, also in twin crystals, fib. and capillary cl. parallel to ooP.	5-6	3·2-3·5	$\dot{\text{Ca}} \ddot{\text{Si}} + [\dot{\text{Mg}} \dot{\text{Fe}}] \ddot{\text{Si}}$

Colour and Streak.	Lustre, &c., and State of Aggregation.	Tests. Blow-pipe characters, &c.	Localities, and Mode of Occurrence.
<p>Pale green or greenish-white, or brownish.</p> <p>White, sk., lightly shining.</p> <p>Olive green and dk. green. Sk. greenish-white.</p>	<p>Vit. transl. to subtransl. Very tough. Slightly greasy.</p> <p>Dull and earthy. Ope. Slightly greasy. Sectile.</p> <p>Met. pearly. Fracture, uneven, splintery.</p>	<p>Infusible alone. Becomes white when heated.</p> <p>Gives a pink colour with Co solution. Yields H, and becomes hard and white when heated.</p> <p>Fuses at the edges only. With Bx fuses with difficulty to a bead. Soluble in H₂SO₄.</p>	<p>China and New Zealand.</p> <p>Occurs in nests in certain sandstones. Obtained chiefly from Anatolia (Asia Minor). Also found near Madrid, and in the Isle of Negropont.</p> <p>Found in a compact rock, called Schiller-stein, near Baste, in the Hartz.</p>
MAGNESIA, &c. H = 5—7. G = 2·9—3·5.			
<p>Dk. green to black.</p>	<p>Vit., inclining to res. Transpt. to ope. Brittle.</p>	<p>Melts easily into a greyish or black glass.</p>	<p>Occurs in granitic and volcanic rocks. Scandinavia, Bohemia, Etna, &c.</p>

NAME.	Crystalline Form and Cleavage.	Hardness.	Specific Gravity.	Chemical Composition.
HORNBLLENDE— Var. { Tremolite. Actinolite. Amphibole. Asbestos.	V. In vertical prisms, with planes of the doma. ooP + (ooPoo) + OP + P. Also col. fib. and gran. cl. ooP per.	5-6	2.9-3.4	$[\overset{\cdot}{\text{Mg}} \overset{\cdot}{\text{Ca}} \overset{\cdot}{\text{Fe}}]_8$ $(\ddot{\text{Si}} \ddot{\text{Al}}_2)_8$
CHRYSLITE (Olivine).	IV. Crystals are rare, cl. brachy-diagonal ooPoo. Usually in imbedded grains.	6.5-7	3.3-3.5	$[\overset{\cdot}{\text{Mg}} \overset{\cdot}{\text{Fe}} \overset{\cdot}{\text{Ca}}]_3 \ddot{\text{Si}}$
CHONDRODITE.	In imbedded grains, or in nodules. Finely gran. structure.	6-6.5	3.1-3.2	$(\overset{\cdot}{\text{Mg}})_8 (\ddot{\text{Si}})_8 +$ $8 [\overset{\cdot}{\text{Mg}} \text{F} + 3 \ddot{\text{Si}} \text{F}_2]$
GROUP IV.—ALUMINA AND HYDROUS SILICATES OF SODA, &c. H = 3.5—5.5.				
**SPINEL— Var. { Ruby. Chloro-spinel. Balas Ruby. Pleonaste.	I. In oct. and dodec. and combinations. O + ooO and O + mOm.	8	3.5-3.6	$\overset{\cdot}{\text{Mg}} \ddot{\text{Al}}_2$
*HALLOYSITE.	Massive, earthy.	1.5-2.5	1.9-2.1	$\ddot{\text{Al}}_2 \ddot{\text{Si}} + 4 \overset{\cdot}{\text{H}}$

Colour and Streak.	Lustre, &c., and State of Aggregation.	Tests. Blow-pipe characters, &c.	Localities, and Mode of Occurrence.
Colourless, pale green, greyish-green or black.	Vit. cl. faces pearly. Subtranspt. to ope.	All varieties fuse easily, forming a colourless or green bead.	It is a constituent of Syenite, and Hornblende Slate. Tremolite occurs in gran. limestone and dolomite. Actinolite and Asbestos occur in Serpentine.
Olive-green or yellowish-green.	Fracture-surfaces have vit. lustre. Transpt. to transl.	Infusible, but becomes darker. Green bead with Bx. Soluble in H ₂ S.	Found in lavas and basalt. The finer crystallized varieties from Constantinople and Brazil. Also occurs in meteoric iron.
Brownish-yellow, reddish, or white.	Vit., inclining to res. Translt. to subtranslt. Fracture uneven.	Fuses with difficulty at the edges.	Occurs in limestone, United States.
ALUMINA (WITH SILICATES OF LIME, G=1·8—2·5.			
Red, blue, green, yellow, black, sk. white. Ruby, red. Balas Ruby, rose-red Almandine Ruby, violet. White or bluish.	Vit. The red varieties transpt., the dk. varieties ope. Semitranslt. Adheres to the tongue.	Infusible alone. With Bx a clear bead, slightly green or red. Infusible. Soluble in H ₂ S, forming a jelly.	Spinel Ruby found in loose grains in rivers, Ceylon, Ava. Other varieties occur in gran. limestone, and in volcanic rocks. Found at Liège and Bayonne (France).

NAME.	Crystalline Form and Cleavage.	Hardness.	Specific Gravity.	Chemical Composition.
ALLOPHANE.	Massive, bot. and ren.	3	1.8-2	$\ddot{\text{Al}}_2 \ddot{\text{Si}} + 5 \dot{\text{H}}$
PINITE (Fahlunite Chlorophyllite).	Massive, and lam. cl. imper.	2-3	2.7	See Iolite.
HEULANDITE.	V. In prms. and combinations. (ooPoo) + ooPoo + Poo + OP. cl. very per. parallel to ooP.	3.5-4	2.2	$\ddot{\text{Al}}_2 (\ddot{\text{Si}})_3 + \dot{\text{Ca}} \ddot{\text{Si}} + 5 \dot{\text{H}}$
SEILBITE.	IV. In various combinations. ooPoo + ooPoo + P + OP. cl. per parallel to ooPoo.	3.5-4	2.13	$\ddot{\text{Al}}_2 (\ddot{\text{Si}})_3 + \dot{\text{Ca}} (\ddot{\text{Si}})_3 + 6 \dot{\text{H}}$
APOPHYLLITE.	II. In prms. ooPoo + OP. cl. very per. parallel to OP.	4.5-5	2.3	$4 (\dot{\text{Ca}})_2 (\ddot{\text{Si}})_3 + \dot{\text{K}} (\ddot{\text{Si}})_3 + \dot{\text{H}}$
LAUMONITE.	V. ooP + OP. cl. per. orthodagonal.	3.5-4	2.3	$\ddot{\text{Al}}_2 (\ddot{\text{Si}})_3 + \dot{\text{Ca}} \ddot{\text{Si}} + 4 \dot{\text{H}}$

Colour and Streak.	Lustre, &c., and State of Aggregation.	Tests. Blow-pipe characters, &c.	Localities, and Mode of Occurrence.
Amber coloured or pale blue or green.	Vit. or res. Translt.	Intumescs, but does not fuse, becomes white and colours the flame green.	It is a product of the decomposition of siliceous rocks. Thuringia and Saxony.
Greyish-green to olive green.	Pearly. Folia. brittle. Semi-translt. to ope.	Fuses at the edges, and yields H when heated.	It is the product of the decomposition of Iolite, and occurs with that mineral in granite in Norway, Sweden, Auvergne, and the Hartz.
White, also greyish or brownish.	Vit. cl. faces pearly. Transpt. to subtranslt. Folia. brittle.	Intumescs or froths before the blow-pipe, fuses, becomes phosphorescent.	Found in amygdaloid and gneiss. Andreasberg, Iceland, Nova Scotia.
White, may be yellowish or brownish.	Vit. cl. faces pearly.	Fuses with intumescence to a colourless glass.	Occurs in amygdaloidal cavities in volcanic rocks. Scotland, Faroe Islands, Tyrol. Also in Silver mines in Norway and the Hartz.
White or greyish or tinged green or red.	Vit. Transpt. to ope.	Exfoliates, and fuses to a white bead.	Occurs in amygdaloidal trap and basalt. Utoe (Sweden), also in Greenland and Siberia.
White, yellowish, or greyish.	Vit. cl. faces pearly. Transpt. to translt. Ope. on exposure.	Swells up and fuses to a white frothy mass. Gelatinizes in nitric acid.	Found in gneiss, porphyry, and clay-slate. Skye, Dumbarton, Faroe Islands, Iceland, and North America.

NAME.	Crystalline Form and Cleavage.	Hardness.	Specific Gravity.	Chemical Composition.
NATROLITE.	IV. ooP + P. cl. ooP per., also glob. and in acic. fibres.	4.5-5.5	2.1-2.3	$\ddot{\text{Al}}_2 (\ddot{\text{Si}})_2 + \dot{\text{Ca}} \ddot{\text{Si}} + 2 \dot{\text{H}}.$
THOMSONITE (Comptonite).	IV. In prms. with pinacoids. oo $\check{\text{P}}\text{oo} + \text{oo}\check{\text{P}}\text{oo} + \text{ooP} + \text{x}\check{\text{P}}\text{oo}$. Also acic. and col. crystals.	5-5.5	2.3-2.4	$3 \ddot{\text{Al}}_2 \ddot{\text{Si}} + 3 \dot{\text{Ca}} \ddot{\text{Si}} + 7 \dot{\text{H}}.$
HARMOTOME.	IV. In combinations of prms. and pyrds. oo $\check{\text{P}}\text{oo} + \text{oo}\check{\text{P}}\text{oo} + \text{P} + \check{\text{P}}\text{oo}$. Often in twin crystals.	4-4.5	2.3-2.5	$\ddot{\text{Al}}_2 (\ddot{\text{Si}})_3 + \dot{\text{Ba}} (\ddot{\text{Si}})_4 + 5 \dot{\text{H}}.$
ANALOIME.	I. In mOm cl. cubical imper.	5-5.5	2.0-2.2	$\ddot{\text{Al}}_2 (\ddot{\text{Si}})_3 + \dot{\text{Na}} \ddot{\text{Si}} + 2 \dot{\text{H}}.$
CHARAZITE— J.F.A. { Herschellite Levyne. Phacolite.	III. In rhombohedrons, also OR + R + $\frac{1}{2}$ R cl. rhombohedral.	4-4.5	2-2.1	$\ddot{\text{Al}}_2 (\ddot{\text{Si}})_3 + \dot{\text{Ca}} [\dot{\text{Na}} \text{ K}] \ddot{\text{Si}} + 6 \dot{\text{H}}$
#PREHNITE.	IV. In prms. with basal plane. ooP + OP, also oo $\check{\text{P}}\text{oo} + \text{ooP} + \text{P}$.	6-7	2.8-2.9	$\ddot{\text{Al}}_2 \ddot{\text{Si}} + 2 \dot{\text{Ca}} \ddot{\text{Si}} + \dot{\text{H}}.$

N.B.—The Minerals from Heulandite to Prehnite, inclusive,

Colour and Streak.	Lustre, &c., and State of Aggregation.	Tests. Blow-pipe characters, &c.	Localities, and Mode of Occurrence.
White, greyish, yellow, or red.	Vit. transpt. to transl. Brittle.	When heated becomes ope. and fuses to a glassy bead.	Found in trap, basalt, and volcanic rocks in Auvergne.
Snow-white, sometimes reddish.	Vit., inclining to pearly. Transpt. to transl. Brittle.	Intumesces, and becomes ope., and fuses at the edges only.	Occurs in amygdaloid in Scotland, and in lavas at Vesuvius.
White, greyish, and yellowish.	Vit. Sub-transpt. to transl. Brittle.	Fuses without intumescence to a clear bead. Phosphoresces when heated.	Found at Andreasberg in amygdaloid, gneiss, and metalliferous veins. Occurs in Scotland as Crosstone.
Colourless, or milk-white.	Vit. Transpt. to ope.	Fuses without intumescence to a clear bead. Gelatinizes in HCl.	Occurs in lavas in Bohemia and India, and in the copper mines of Lake Superior district.
White, yellowish, or red.	Vit. Transpt. to transl.	Intumesces, coloured varieties become white.	Found in volcanic rocks in Scotland, Bohemia, Tyrol.
Colourless, or pale green.	Vit. Pearly on OP. Sub-transpt. to transl.	Intumesces and melts to a slag of a light green colour.	Found in trap, gneiss, and granite. Fassa Valley (Tyrol), Dauphiny, and Lake Superior district.

are called Zeolites, because they melt and intumesce when heated.

NAME.	Crystalline Form and Cleavage.	Hardness	Specific Gravity.	Chemical Composition.
GROUP V.—ANHYDROUS SILICATES OF ALUMINA H = 5.5 — 7.5				
SILLIMANITE.	VI. In slender prisms. cl. macro-diagonal very per., also in crystalline aggregates.	6-7.5	3.2-3.3	$\overset{\cdot\cdot}{\text{Al}}_2 \overset{\cdot\cdot}{\text{Si}}$
KYANITE— VAR { Disthene. { Rhæticigite.	VI. In long flat col. prisms. ooPoo + OP + ooP cl. orthodiagonal very per.	5-7	3.6-3.7	$\overset{\cdot\cdot}{\text{Al}}_2 \overset{\cdot\cdot}{\text{Si}}$
ANDALUSITE (Chiastolite).	IV. ooP + OP cl. ooP rather indist.	7.5	3.1-3.3	$\overset{\cdot\cdot}{\text{Al}}_2 \overset{\cdot\cdot}{\text{Si}}$
STAUROLITE.	IV. In cross-shaped twin crystals. ooP + ooPoo + OP cl. brachy-diagonal per.	7-7.5	3.6-3.7	$(\overset{\cdot\cdot}{\text{Al}}_2 \overset{\cdot\cdot}{\text{Fe}}_2)_4 (\overset{\cdot\cdot}{\text{Si}})_3$
LEUCITE.	I. In icositetrahedrons. cl. cubical very imper.	5.5-6	2.4	$\overset{\cdot\cdot}{\text{Al}}_2 (\overset{\cdot\cdot}{\text{Si}})_3 + \overset{\cdot}{\text{K}} \overset{\cdot\cdot}{\text{Si}}$
ORTHOCLASE or Common Felspar— Var. { Adularia. { Moonstone. { Glassy { Felspar. { Aventurine { Felspar.	V. In thick rectangular prisms. ooP + OP + Poo. Often in twin crystals, cl. brachy-diagonal per., also in crystalline masses.	6	2.3-2.6	$\overset{\cdot\cdot}{\text{Al}}_2 (\overset{\cdot\cdot}{\text{Si}})_3 + \overset{\cdot}{\text{K}} (\overset{\cdot\cdot}{\text{Si}})_3$

Colour and Streak.	Lustre, &c., and State of Aggregation	Tests Blow-pipe characters, &c.	Localities, and Mode of Occurrence.
(WITH SILICATES OF Na, K, Ca, &c.). G = 2.4 — 4.			
Hair-brown.	Vit., inclining to pearly. Translt.,	Infusible alone and with Bx.	Occurs in gneiss at Chester; also in Norway and Connecticut.
Light blue or greyish.	Pearly. Rather brittle. Translt at the edges.	Unaltered alone, with Bx forms a transpt. colourless glass.	Occurs in white mica-schist in the Swiss Alps.
Grey, brownish, or peach-bloom.	Dull vit. Pearly on terminal planes. Translt. to ope.	Infusible alone. Difficultly fusible with Bx.	Found in the Alps and Tyrol. Chialtolite is found at Kildaw (Cumberland), in Wicklow, and in Brittany.
Reddish-brown to black. Sk. white.	Vit., inclining to res. Translt. to ope.	Infusible, but becomes darker. With Bx forms a dk. green glass.	Found in gneiss and mica-slate, St. Gothard (Switzerland), and the Tyrol.
Ash-grey, occasionally pink.	Dull vit. Translt. to ope.	Fuses difficultly with Bx to a clear bead. Blue colour with Co solution.	Occurs in lava, Vesuvius.
White, grey, brown, or flesh-red.	Vit., pearly on cl. faces. Moonstone opalescent. Glassy felspar clear and colourless.	Fusible alone at the edges only. With Bx a clear bead.	It is a constituent of granite, and it occurs imbedded in porphyry. Adularia is found at the Pass of St. Gothard. Glassy Felspar in lavas. Other localities are Cornwall, Mourne Mountains, Norway, Carlsbad, and Piedmont.

NAME.	Crystalline Form and Cleavage.	Hardness.	Specific Gravity.	Chemical Composition.
ALBITE and ANORTHITE.	VI. In forms like Orthoclase. Often in twin crystals, also massive. Anorthite in tab. crystals.	6	2.6-2.7	$\ddot{\text{Al}}_2 (\ddot{\text{Si}})_3 + \dot{\text{Na}} (\ddot{\text{Si}})_3$
LABRADORITE and OLIGOCLASE.	VI. See Albite and Anorthite.	6	2.6-2.7	$\ddot{\text{Al}}_2 (\ddot{\text{Si}})_3 + (\dot{\text{Ca}} \dot{\text{Na}}) \ddot{\text{Si}}$ (Labradorite) $2 \ddot{\text{Al}}_2 (\ddot{\text{Si}})_3 + (\dot{\text{Na}})_2 (\ddot{\text{Si}})_3$
NEPHELINE.	III. In prisms. ooP + OP. cl. basal and ooP imper.	5.5-6	2.4-2.6	$(\ddot{\text{Al}})_4 (\ddot{\text{Si}})_5 + 4 [\dot{\text{Na}} \dot{\text{K}}] \ddot{\text{Si}}$
SCAPOLITE (Meionite).	II. In long prisms. cl. prismatic, ooPoo rather per., also massive and gran.	5-6	2.6-2.7	$(\ddot{\text{Al}})_2 \ddot{\text{Si}} + 3 [\dot{\text{Ca}} \dot{\text{Na}}] \ddot{\text{Si}}$
PETALITE.	Occurs in foliated masses.	6-6.5	2.4	$4 \ddot{\text{Al}}_2 (\ddot{\text{Si}})_3 + 3 [\dot{\text{Li}} \dot{\text{Na}}] (\ddot{\text{Si}})_4$

Colour and Streak.	Lustre, &c., and State of Aggregation.	Tests. Blow-pipe characters, &c.	Localities, and Mode of Occurrence.
White, tinged with grey, red, or green.	Vit. to pearly. Transpt. to subtranslt.	Less fusible than Orthoclase, tinges flame yellow. Not affected by acids. Anorthite soluble in H ₂ S.	It often replaces Orthoclase in rocks. Crystals occur in Norway, Tyrol, Dauphiné.
Dk. grey or brown. Exhibits internal reflections of green, purple, blue, golden-yellow. Oligoclase white.	Vit., cl. faces, pearly. Translt. to subtranslt. Oligoclase dull vit.	More fusible than Orthoclase. Soluble in HCl. Oligoclase difficultly fusible and not attacked by acids.	Labradorite occurs in some granites in Labrador. Oligoclase occurs in the granite of Scandinavia.
Grey, yellowish, or greenish.	Vit. or greasy. Translt. to ope.	Infusible, except at the edges. Becomes clouded in nitric acid.	Occurs in lavas at Vesuvius.
White, pale blue, green, or red.	Vit., sometimes pearly. Transpt. to subtranslt.	Fuses with effervescence to a porous glass. Blue colour with Co solution.	Crystals are found in Norway, Sweden, Finland, and at Vesuvius.
Greyish, tinged with pink. Sk. white.	Vit. or pearly. Translt. Phos. phosphorescent.	Fuses readily to a porous glass. The Li colours the flame red	Found in Sweden, and in gran. limestone at Bolton (Massachusetts).

NAME.	Crystalline Form and Cleavage.	Hardness.	Specific Gravity.	Chemical Composition.
SPODUMENE.	✓ Occurs massive and foliated, cl. brachy-diagonal per.	6.5-7	3.1	$4 \ddot{\text{Al}}_2 (\ddot{\text{Si}})_3 + 3 [\ddot{\text{Li}} \ddot{\text{Na}} \ddot{\text{K}}] \ddot{\text{Si}} [\ddot{\text{Ca}} \ddot{\text{Mg}} \ddot{\text{Fe}}]_3 (\ddot{\text{Si}})_2 + 2 [\ddot{\text{Al}}_2 \ddot{\text{Fe}} \ddot{\text{Mn}}_2] \ddot{\text{Si}}$
EPIDOTE (Thulite Magnesian Epidote).	V. In prms. with planes of a doma., cl. ortho-diagonal very per.	6-7	3.2-3.4	
IDOCRASE (Vesuvian).	II. ooP + ooPoo + OP + P + Poo. Also massive and gran.	6.5	3.3 3.4	$3 [\ddot{\text{Ca}} \ddot{\text{Mg}} \ddot{\text{Fe}}] \ddot{\text{Si}} + 2 \ddot{\text{Al}}_2 (\ddot{\text{Si}})_3$
GARNET— Varieties. { Essonite. Melanite. Grossularia. Ouvarovite. Aplome. Pyrope.	I. In rhombic dodec; also in mOm and mO. cl. parallel to rhombic dodec; also massive.	6.5-7.5	3.5-4.3	$[\ddot{\text{Fe}} \ddot{\text{Ca}} \ddot{\text{Mn}}]_3 (\ddot{\text{Si}}) + [\ddot{\text{Al}}_2 \ddot{\text{Fe}}_2] \ddot{\text{Si}}$
TOURMALINE— Var. { Rubellite. Schorl.	III. In long prms. striated, and hemimorphic, also col. and rad.	7.8	3	$[\ddot{\text{Al}}_2 \ddot{\text{Mn}}_2 \ddot{\text{Fe}}_2] (\ddot{\text{Si}})_3 + [\ddot{\text{Mg}} \ddot{\text{Fe}} \ddot{\text{Na}} \ddot{\text{K}} \ddot{\text{Li}}] \ddot{\text{Si}}$

Colour and Streak.	Lustre, &c., and State of Aggregation.	Tests. Blow-pipe characters, &c.	Localities, and Mode of Occurrence.
Grey, or pale green.	Vit., cl. faces, pearly. Translt. at the edges.	Intumesces slightly, and fuses easily to a colourless glass.	The chief localities are Scotland, Scandinavia, the Tyrol, and North America.
Yellowish-green or greyish-brown.	Vit. or pearly. Translt. to ope.	Fusible. Gelatinizes in HCl.	Occurs in crystalline and metamorphosed rocks.
Green, and also brownish.	Vit. or res. Sub-transpt. to ope.	Fuses with effervescence to a yellow translt. bead.	Occurs chiefly at Monte Somma; also in Piedmont, Norway, and Siberia.
Garnet blood-red or reddish-brown. Essonite red or orange-yellow. Grossularia white and green. Melanite black. Aplome deep brown.	Vit. Transpt. to ope. Grossularia translt. Melanite ope. Colophonite res. and iridescent.	All varieties are fusible to a dk. vit. bead.	Garnet occurs in gneiss and mica-slate; also in granite, serpentine, and lavas. Fahlun, Kongsberg, the Tyrol, and the Urals; also in Greenland and Ceylon. Essonite in Sweden and Ceylon. Grossularia occurs in Siberia. Melanite in Vesuvian lavas.
Black, lt. green, and dk. brown. Rubellite red. Schorl black.	Vit., inclining to res. Translt. to nearly ope. Dichromatic.	Dk. varieties intumesce and fuse with difficulty. Red and green varieties become white. Pyro-electric.	It occurs in granite, gneiss, and mica-slate, and often as an essential part of the vein of Tin ore. The best crystals are from Elba and Brazil.

NAME.	Crystalline Form and Cleavage.	Hardness.	Specific Gravity.	Chemical Composition.
AXINITE.	VI. In very acute prms., cl. indist.	6·5-7	3·2	$2 [\overset{\cdot}{\text{Ca}} \overset{\cdot}{\text{Mg}}]_2 (\ddot{\text{Si}})_3$ $3 [\ddot{\text{Al}}_2 \ddot{\text{Fe}}_2 \ddot{\text{Mn}}_2]$ $\ddot{\text{Si}} + [\overset{\cdot}{\text{Ca}} \overset{\cdot}{\text{Mg}}] \ddot{\text{B}}$
IOLITE (Cordierite Dichroite).	IV. In large prms., with terminal planes. cl. indist.	7-7·5	2·6-2·7	$(\ddot{\text{Al}}_2)_2 (\ddot{\text{Si}})_3 +$ $2 [\overset{\cdot}{\text{Mg}} \overset{\cdot}{\text{Fe}}] \ddot{\text{Si}}$
*MICA— { Biotite. Lepidolite. Margarite. Lepidomelane. Var.	V. In rhombic or six-sided tables, cl. basal, highly per. Usually in foliated masses, plates, or scales.	2-2·5 (Biotite) 2·5 3	2·8-3	$[\overset{\cdot}{\text{Fe}} \overset{\cdot}{\text{Mg}} \overset{\cdot}{\text{K}}]_3 \ddot{\text{Si}}$ $+ [\ddot{\text{Fe}}_2 \ddot{\text{Al}}_2] \ddot{\text{Si}}$
GROUP VI.—INCLUDING SILICATE OF ALUMINA AND SULPHATE OF IRON, SILICATES AND ALUMINATES OF H = 7·5—8·5				
TOPAZ.	IV. In long prms. striated longitudinally. ooP + 2 $\ddot{\text{Poo}}$ + oo $\ddot{\text{P}}$ 2 + P. cl. basal very per.	8	3·5	$6 \ddot{\text{Al}}_2 \ddot{\text{Si}} + \text{Al}_2 \text{F}_3$ Si F_3

Colour and Streak.	Lustre, &c., and State of Aggregation.	Tests. Blow-pipe characters, &c.	Localities, and Mode of Occurrence.
Dk. brown or purplish-brown.	Vit., transpt. to subtranslt. Trichromatic.	Fuses easily with intumescence to a dk. green glass. Pyro-electric.	Found associated with Sn and Cu, Botallack Mine, Cornwall, and near Dartmouth; also occurs in Dauphiné and Norway.
Violet or blue. Sk. uncoloured.	Vit. Glassy. Transpt. to translt. Brittle.	Fuses slowly to a clear glass. Exhibits dichroism.	Found in granite and gneiss; Finland, Bavaria, Norway, Ceylon.
Colourless, yellowish or brown. Biotite dk. green. Lepidolite purple. Lepidomelane black. Margarite white or grey.	Pearly. Transpt. to translt. Tough. Lamæ very thin and elastic.	Infusible, but becomes op. and white. Lepidomelane tinges the flame crimson. Biotite fuses to a dk. glass.	Mica is a constituent of granite, gneiss, mica-schist, &c. Margarite is found in the Tyrol. Biotite occurs in the neighbourhood of Vesuvius. Lepidolite occurs in Cornwall, Bohemia, and Saxony.
FLUORINE, SILICATE OF ALUMINA AND GLUCINA, AND SILICATE OF ZIRCONIA. G = 2.5—4.			
Colourless or pale yellow, rarely pink, green, or blue. Sk. white.	Vit. Transpt. to subtranslt. Fracture conchoidal.	Infusible alone. Fuses slowly with Bx to a transpt. glass. Yellow varieties turn pink when heated. Pyro-electric.	Occurs in granite with Beryl, Tourmaline, and Quartz in the Ural and Altai Mountains, and Siberia. Found loose in gravels in Brazil and Ceylon. Small crystals at St. Michael's Mount (Cornwall), and in the Sn mines of Bohemia.

NAME.	Crystalline Form and Cleavage.	Hardness.	Specific Gravity.	Chemical Composition.
*LAPIS-LAZULI (Ultramarine).	I. Rarely in rhombic dodec. cl. ooO imper. Usually massive.	5.5	2.3-2.5	Unknown. Silicate of Alumina, Sulphate of Iron, with Magnesia, Lime, Soda, and Chlorine.
BERYL— Var. { Emerald. Aquamarine.	III. In large hexagonal prisms, with terminal planes. cl. basal rather per.	7.5-8	2.6	$\ddot{\text{Al}}_2 (\ddot{\text{Si}})_3 + \ddot{\text{G}}_2$ $(\ddot{\text{Si}})_3$ (Emerald contains $\ddot{\text{Cr}}_2$)
EUCLASE.	V. In prisms. ooP + (ooPoo) + P. cl. clinodiagonal highly per.	7.5	2.9-3.1	$3 \ddot{\text{Al}}_2 \ddot{\text{Si}} + (\ddot{\text{G}}_2)_3$ $(\ddot{\text{Si}})_4$
CHRYSOBERYL (Cymophane).	IV. ooPoo + ooPoo + Poo + P. cl. brachydiagonal imper. Often in twin crystals.	8.5	3.5-3.8	$\ddot{\text{G}}_2 (\ddot{\text{Al}}_2)_3$
ZIRCON— Var. { Jacinth or Hyacinth. Jargon.	II. In prisms. and prisms. ooP + P + ooPoo. cl. OP and ooP imper.	7.5	4-4.8	$(\ddot{\text{Zr}})_2 \ddot{\text{Si}}$

Colour and Streak.	Lustre, &c., and State of Aggregation.	Tests. Blow-pipe characters, &c.	Localities, and Mode of Occurrence.
Fine azure blue. Sk. light blue.	Vit. Translt. to ope.	Fuses easily to a white porous glass. Gelatinizes in HCl.	Occurs in granite and gran. limestone. China, Thibet, Tartary, and in the Andes.
Beryl, bluish. Emerald, green. Aquamarine, pale blue.	Vit. or res. Transpt. to sub-translt. Aquamarine very transpt. Brittle.	Becomes clouded when heated, and fuses only at the edges.	Emerald occurs in Dolomite in Grenada, and in Siberia. Found also in Salzburg and the Ural Mountains. Beryl and Aquamarine in Brazil and United States.
Pale green.	Vit. Transpt. Very brittle.	Intumesces and fuses to a white enamel. Pyro-electric.	Found in Peru and Brazil.
Bright green or pale green. Sk. uncoloured.	Vit. Transpt. to translt.	Infusible alone. Difficultly fusible with Bx.	North America, Siberia, Brazil, Ceylon.
Colourless, greyish or reddish-brown. Hyacinth, red. Jargon, colourless.	Admt. Transpt. to ope. Fracture conchoidal brilliant. Hyacinth, transpt. Jargon, ope.	Infusible alone, but loses colour. Fusible with Bx.	Found in lavas and igneous rocks. Norway, Bohemia, Auvergne, Ceylon.

NAME.	Crystalline Form and Cleavage.	Hardness.	Specific Gravity.	Chemical Composition.
GROUP I.—Ti H=5—6·5.				
RUTILE.	II. Irregularly crystalline, rad. in quartz, lateral cl. dist.	6·6·5	4·2	⌘Ti
ANATASE.	II. In pyramids more acute than those of rutile.	5 5-6	3·8	⌘Ti
BROOKITE.	IV. Occurs in tab. and thin hair-brown crystals.	5·5-6	4·1	⌘Ti
SPHENE.	V. Occurs in tab. and wedge-shaped crystals.	5·2	3·5	(Ca + ⌘Ti) ⌘Si
GROUP II.—Mo — Te				
*MOLYBDENITE.	III. Occurs in thin foliated plates, lamæ. flexible.	1-1·5	4·5	// Mo
*NATIVE TELLURIUM.	VI. Occurs in six-sided prisms, and massive.	2-2·5	6·1-6·3	Te (with a little Au).

Colour and Streak.	Lustre, &c., and State of Aggregation.	Tests. Blow-pipe characters, &c.	Localities, and Mode of Occurrence.
G = 3.5 — 4.2.			
Reddish-brown. Sk. pale brown.	Submet. to adm't., transpt. to ope.	Unaltered alone. With Bx a hyacinth-red bead.	Found embedded in granite, gneiss, syenite, and gran. limestone in the Alps and Norway.
Dk. brown, blue, and red.	Met. Sub-transpt.	Loses colour and fuses with difficulty with Bx.	Occurs in the Alps with Axinite, also in the Tyrol, and in Brazil.
Red and brown.	Transpt. to ope.	Infusible alone.	Found in the lavas of Mount Etna, also in Dauphiné and at Snowdon.
Pale and dk. green, also brownish-yellow, grey, and black. Sk. uncoloured.	Admt. to res., transpt. to ope.	Yellow varieties do not alter in colour, others turn yellow, fuse on the edges with intumescence to a dark glass.	Occurs in disseminated crystals in granite, gneiss, and gran. limestone. Argyleshire, Norway, St. Gothard, Mont Blanc, and Piedmont.
H = 1 — 2. G = 7 — 8.			
Bluish grey. Sk. slightly greenish.	Met., resembling graphite.	Gives off S when heated. Soluble in Nitric acid.	Found with Sn ores in Cornwall, also in Cumberland. Occurs in granite, gneiss, &c. Bohemia and Sweden are other localities.
Tin-white.	Bright met. brittle.	Combustible. Less fusible than Pb.	Found in primary rocks. Transylvania and Hungary.

NAME.	Crystalline Form and Cleavage.	Hardness.	Specific Gravity.	Chemical Composition.
FOL. TELLURIUM.	II. Lam. and gran. lamæ., flexible.	1-1.5	7	$\dot{\text{Pb}} \ddot{\text{Te}}$
TETRADYMIT.	III. Crystals are roughly developed; occurs also lam. and foliated.	2	8	$2 \text{ Bi } \text{Te}_3 \overset{///}{\text{Bi}}$
GROUP III.—Wo — Ur.				
WOLFRAM.	IV. Occurs in vertical prisms, strongly striated.	5.5	7.4	$(\dot{\text{Fe}} \dot{\text{Mn}}) \ddot{\text{W}}$
SCHHEELITE.	II. In pyramids cl. per. also massive.	4-4.5	6	$\dot{\text{Ca}} \ddot{\text{W}}$
PITCHBLEND.	Amorphous, lam., massive, and bot.	5.5	6.4	$2 \dot{\text{U}}_1 \ddot{\text{U}}_2$
GROUP IV.—Bi.				
*NATIVE BISMUTH.	III. Cl. rhombohedral per., sometimes massive, gran. or foliated.	2-2.5	9.7	Bi (with traces of As)

Colour and Streak.	Lustre, &c., and State of Aggregation.	Tests. Blow-pipe characters, &c.	Localities, and Mode of Occurrence.
Lead colour.	Met., resembles graphite. Sectile.	Melts easily, giving off vapour, and leaving a yellow incrustation.	Offenbanya, Transylvania.
Pale steel-grey. Sk. like that of Molybdenite.	Flexible in thin plates.	Decrepitates, fuses and burns with a livid flame. S is given off	Generally contains Pb and Au. Frequently found associated with Au, as in Wales and America. Also found at Schemnitz.
H = 4—5.5. G = 6—7.4.			
Dk. greyish-black. Sk. dk. reddish-brown.	Strong met., shining or dull.	Fuses with difficulty. Green bead with Bx.	Found with Sn ores in Cornwall and in the United States.
Yellowish-white.	Vit. or res., sub-transp. to ope.	Decrepitates and fuses with difficulty.	Occurs in primary rocks in Cornwall, Devonshire, Bohemia, and Saxony.
Grey, brown, or velvet black.	Submet. or dull.	Infusible alone. A grey scoria with Bx	Found with Sn in Cornwall, and in Ag mines, Bohemia.
H = 2—4. G = 6—7.			
Silver white with a tinge of red.	Strong met.	Volatilizes, leaving a yellow incrustation, soluble in Nitric Acid.	Found in granite. It accompanies Cu in Cornwall and Cumberland. Occurs arborescent at Schneeberg, and with the ores of Ag and Co in Saxony and Bohemia.

NAME.	Crystalline Form and Cleavage	Hardness.	Specific Gravity.	Chemical Composition.
BISMUTHITE.	Amorphous, massive.	4-4.5	6.8-7.5	$\text{Bi } \bar{\text{C}}$
BISMUTH-GLANCE.	IV. Occurs in acic., rad., and long prismatic crystals, also gran. and fib.	2-2.5	6.5	Bi
BISMUTH-BLENDE.	I. Occurs in $\frac{0}{2}$, also massive and col. <i>hucor</i>	3.5-4.5	6	$\text{Bi } (\bar{\text{Si}})_2$

GROUP V.—As — Sb.

NATIVE ARSENIC.	III. Cl. basal imper. Occurs bot., col., mam., and gran.	3.5	5.6-5.8	As (with Sb, Ag, Co, Ni, or Sn).
REALGAR.	V. Occurs in oblique prisms, also massive.	1.5-2	3.5	As
ORPIMENT.	IV. In prismatic crystals or foliated masses. cl. diagonal per, crystals. $\text{ooP} + \bar{\text{Poo}}$.	1.5-2	3.4-3.5	As

Colour and Streak.	Lustre, &c., and State of Aggregation.	Tests. Blow-pipe characters, &c.	Localities, and Mode of Occurrence.
Grey, also greenish or yellowish.	Dull or weak vit. Ope. Very brittle.	Decrepitates, fuses easily, and is reduced to met. state on charcoal.	Found in the Arme Hulfe Mine at Ullersreuth, also at Schneeberg and Johann-Georgenstadt, and at St. Agnes (Cornwall).
Bright steel-grey or tin-white.	Feebly met. Isomorphous with Sb.	Fuses, yields metallic bead of Bi and yellow incrustation.	Found at Redruth (Cornwall). It accompanies copper pyrites, and occurs also in Sweden and the Hartz Mountains.
Yellow to dk. brown or greyish.	Res to adm.	Fuses to a brownish glass, with white fumes.	Occurs in primary rocks, chiefly in Saxony.
H = 1·5—3·5. G = 3·5—5·8.			
Tin-white or lead-grey.	Met. Sec- tile and brittle.	Volatilizes readily with odour of garlic.	Occurs with Pb and Ag ores at Freiberg and Schnee-berg, and in the cross veins of the Hartz Mines.
Clear red to orange.	Res., transpt. to translt.	Volatilizes and burns with a blue flame when heated on charcoal.	Occurs with Te and Au in Transylvania and Hungary.
Colour and sk. fine yellow.	Brilliant pearly, met. pearly on cl. faces. Sub-transpt. to translt.	Fuses easily and burns in the air with a pale blue flame. Crystals are flexible.	Obtained from Hungary, Turkey, China, North and South America.

NAME	Crystalline Form and Cleavage.	Hardness	Specific Gravity	Chemical Composition.
*NATIVE ANTIMONY.	III. Occurs lam., massive, bot., and gran. Cl. parallel to basal plane.	3.5	6.6	Sb (with Pb, Ag, As).
ANTIMONY-GLANCE (Grey Antimony).	IV. Occurs in obtuse rhombic pyramids, also acic. and gran.	2	4.6	Sb
WHITE ANTIMONY.	IV. In rad. crystals, with glob. extremities, also tab., col., and gran.	2.5-3	5.5	Sb

GROUP VI.—Fe.

*NATIVE IRON.	I. Occurs in O. cl. parallel to faces of O, also massive and gran.	4.5	7.3-7.8	Fe (with C, Ni, &c.)
MAGNETITE.	I. In O and ooO gran. and crystalline.	5.5-6.5	5	Fe_2Fe (Fe=72 p.ct.)
RED HEMATITE (Specular Iron).	III. Occurs in tab. crystals, also earthy, fib., and glassy.	5.5-6	4.5-5.3	Fe_2 (Fe=70 p.ct.)

Colour and Streak.	Lustre, &c., and State of Aggregation.	Tests. Blow-pipe characters, &c.	Localities, and Mode of Occurrence.
Colour and Sk. tin-white, sometimes lead-blue.	Met. brilliant. Compact and brittle.	Fuses easily and volatilizes in white fumes.	Found at Dauphiné, Andreasberg, in the Hartz, and in Mexico.
Colour and Sk. lead-grey, or steel-grey.	Shining. Brittle, lamæ., subflexible.	Fuses readily, gives off white fumes and sulphurous odour.	Found with the ores of Pb, Ag, Zn, and Fe, associated with Heavy-spar and Quartz; Kremnitz, Felsőbauya, the Hartz, and Spain. Occurs also in Wales and Cornwall.
White, yellowish, and brownish.	Admt. to pearly.	Burns in the air. Soluble in HCl.	Occurs in Bohemia, Saxony, and Hungary.
H = 4·5—6·5 G = 3·6—5·3.			
Colour and Sk. iron-grey.	Met. Very tenacious. Malleable and ductile. Fracture hackly.	Acts strongly on the magnet.	Occurs in meteoric stones, in South America and Saxony; also in very small quantities in igneous rocks as basalt.
Colour iron-black. Sk. black.	Met. or dull and ope. Brittle.	Infusible alone. Yields a green glass with Bx. strongly magnetic, sometimes exhibits polarity.	Occurs in granite, gneiss, clay-slate, hornblende, and limestone, in Norway, Sweden, Cornwall, and Devon. Lodestone occurs in Siberia and Elba, Russia, India.
Dk. steel-grey or black. Sk. blood-red.	Crystals have strong steely lustre.	Infusible alone. Green bead with Bx in inner flame. Yellow bead in outer flame.	Occurs in primary stratified and volcanic rocks. Localities—Derbyshire, Flintshire, Belgian coal-fields, Norway, Sweden, Elba.

NAME	Crystalline Form and Cleavage.	Hardness.	Specific Gravity.	Chemical Composition.
BROWN HEMATITE (Limonite Gôthite).	IV. Occurs in rhombic prisms; also acic. and fib., massive, bot., and stalactitic.	5-5.5	3.6-4	$\ddot{\text{Fe}}_2 + \dot{\text{H}}$
SPATHIC IRON ORE (Chalybite).	III. In rhombohedrons and scalenohedrons, massive, and in glob. concretions.	3-4.5	3.7-3.8	$\dot{\text{Fe}} \ddot{\text{C}}$ (Fe = 62 p.ct.)
IRON PYRITES.	I. In oct. cubes and $\frac{\text{ooOn}}{2}$, and combinations of these.	6-6.5	5	$\overset{''}{\text{Fe}}$ (Fe 47 p.ct.)
PYRRHOTINE (Magnetic Iron Pyrites).	III. In tab. hexagonal prisms, and massive.	3.5-4.5	4.5	$\overset{'}{\text{Fe}} + \overset{''}{\text{Fe}}$ (also Ni or Co)
*MISPICKEL (Arsenical Iron-pyrites).	IV. In rhombic prisms. ooP strongly striated, also massive.	5.5-6	6-6.2	$\overset{''}{\text{Fe}} + \text{Fe As}$ (Fe = 34 p.ct.)
**COPPERAS (Green Vitriol).	V. In oblique prisms. Generally massive.	2	1.8	$\dot{\text{Fe}} \ddot{\text{S}} + 7 \dot{\text{H}}$

Colour and Streak.	Lustre, &c., and State of Aggregation.	Tests. Blow-pipe characters, &c.	Localities, and Mode of Occurrence.
Dk. brown and brownish-yellow. Sk. yellowish-brown.	Submet. Sometimes dull and earthy. Subtranspt. to ope.	Yields H when heated in a glass tube. Soluble in acids.	Found in Cornwall, Somersetshire, and Prussia.
Light-grey to brown, also yellowish. Sk. uncoloured.	Pearly to vit. Translt. to ope.	Blackens when heated, and becomes magnetic.	Occurs in spherical masses in the clay of the Coal-measures, England, Wales, Scotland. Occurs in gneiss in Styria and Carinthia.
Brass yellow, often iridescent when tarnished.	Strong met. Brittle.	Gives off S when heated, and leaves a bead attractive by the magnet.	It is found in rocks of all ages; Cornwall, Wicklow, Sweden, Elba, Portugal, Peru, United States.
Bronze-yellow to copper-red. Sk. dk. grey.	Brittle. Slightly attracted by the magnet.	In inner flame fuses, and gives a black metallic bead, which is magnetic.	Found with Au in Brazil and California. Occurs massive in Cornwall, Saxony, and in the Hartz.
Silver-white or steel-grey.	Shining lustre. Brittle.	Gives off fumes of As, and leaves a magnetic bead.	Occurs in quartz vein-stone, and in gran. masses with Sn and Cu Pyrites, also found with ores of Pb and Ag. Cornwall and Freiberg.
Bluish-green or grass-green. More soluble in warm than in hot H.	Vit. Subtranspt. to translt. Brittle. Taste astringent met.	Crystals effloresce readily. With tincture of galls gives a black colour.	It is the result of the decomposition of Fe. Ram-melsberg in the Hartz is a noted locality.

NAME.	Crystalline Form and Cleavage.	Hardness	Specific Gravity	Chemical Composition.
**VIVIANITE.	V. In oblique prms., also as an incrustation.	1·5-2	2·6	$(\dot{\text{Fe}})_8 \ddot{\text{P}} + 8 \dot{\text{H}}$
GROUP VII.—Cr and Mn.				
CHROMITE (Chrom. Iron Ore).	I. In oct., but rarely in crystals. Usually massive, and coarsely gran.	5·5	4·5	$\dot{\text{Fe}} \ddot{\text{Cr}}_2$ ($\ddot{\text{Cr}}_2$ 60 p. ct.) also $\ddot{\text{Al}}_2$ and $\dot{\text{Mg}}$
BRAUNITE.	II. In pyrds., with OP crystals, are small.	6-6·5	4·8	$\ddot{\text{Mn}}_2$ (Mn=69 p.ct.)
HAUSSMANNITE.	II. Often in twin crystals.	5-5·5	4·7	$\dot{\text{Mn}} + \ddot{\text{Mn}}_2$ (Mn=72 p.ct.)
*MANGANITE.	IV. In rhombic prms., strongly striated parallel to principal axis.	4-4·5	4·3	$\ddot{\text{Mn}}_2 + \dot{\text{H}}$
*PYROLUSITE.	IV. In rectangular prms., also massive, bot., fib.	2-2·5	4·7-5	$\ddot{\text{Mn}}$ (Mn=63 p.ct.)

Colour and Streak.	Lustre, &c., and State of Aggregation	Tests. Blow-pipe characters, &c.	Localities, and Mode of Occurrence.
Deep blue or green. Sk. bluish.	Pearly to vit. Transpt. to transl., ope. on exposure. Thin lamæ, flexible.	Loses colour when heated and becomes ope. Yields H in a glass tube. Soluble in Nitric Acid.	Found with Fe, Cu, and Sn ores in clay, or with bog-iron ore. St. Agnes (Cornwall), Transylvania and United States, Amberg (Bavaria), Haarlem (New Jersey).
H=5—6·5. G=3·7—4·7.			
Iron-black and brownish-black. Sk. dk. brown.	Submet. No lustre on fractured surface.	Sometimes magnetic in small fragments. Green bead with Bx.	Found in Serpentine and in crystalline limestone. Shetland Isles, France, Styria, Silesia, Bohemia, Norway.
Colour and sk. brownish-black.	Met. to submet.	Infusible alone. With Bx an amethyst bead.	Occurs in the Hartz mines, also in Thuringia and Piedmont.
Iron-black. Sk. brown.	Submet.	See Braunitite.	Found in veins in porphyry with Manganite near Ilmenau (Thuringia), and in Alsatia.
Steel-grey to iron-black. Sk. reddish-brown.	Strong met.	Frequently occurs in pedomorphs of calc-spar. Infusible.	Wales, Hartz Mountains, Bohemia, and Saxony.
Iron-black. Sk. black.	Non-met. often dull.	Infusible. When treated with HCl odour of Cl evolved.	Found at Ilmenau, and Friedrichsrade (Thuringia), Zellerfeld (Hartz), Trübau (Moravia), Hirschberg (Westphalia). In veins of Iron ore in the mines of Bohemia. Also in Styria, Carinthia, Hesse, Silesia.

NAME	Crystalline Form and Cleavage.	Hardness.	Specific Gravity.	Chemical Composition.
*WAD.	Amorphous, earthy, also as an incrustation.	1	3.7	$\dot{\text{Mn}} + \ddot{\text{Mn}}_2$ (with $\dot{\text{Fe}}$ $\ddot{\text{Co}}$ or $\ddot{\text{Cu}}$)
PSILOMELANE.	Amorphous, surface smooth mam., also massive and bot.	5.5-6	4.1	$\dot{\text{Mn}} + \ddot{\text{Mn}}$ (variable)
RHODONITE (Manganese-spar).	V. In prisms, usually massive, cl. ooPoo per.	5.5-6.5	3.4-3.7	$(\dot{\text{Mn}})_3 (\ddot{\text{Si}})_3$
*DIALLOGITE.	III. In rhombohedrons, and forms like those of calc-spar.	3.5	3.5	$\dot{\text{Mn}} \ddot{\text{C}}$
GROUP VIII.—Ni—Co.				
CLOANTHITE (White Nickel).	I. In cubes.	5.5-6	6.4-6.7	Ni As (Ni=28 p.ct.)
NICKEL-GLANCE (Gersdorffite).	I. In cubes, also massive, cl. cubical per.	5.5	6.1	Ni As_2 (Ni=30 p.ct.)

Colour and Streak.	Lustre, &c., and State of Aggregation.	Tests. Blow-pipe characters, &c.	Localities, and Mode of Occurrence.
Colour and sk. dk. brown to black.	Dull and earthy.	Gives off H when heated. Violet bead with Bx.	Occurs in the peat bogs of Ireland, in Liassic limestone, and in slaty rocks, <i>e.g.</i> , Cambrian.
Dk. grey to iron-black. Sk. brownish-black, shining.	Submet. ope.	Yields H when heated. Violet bead.	Occurs in beds of Pyrolusite and Manganite, and in veins in porphyry. Found at Mariaspring, near Göttingen. In beds of Iron ore at Elbingerode, also near Ilmenau. In veins in granite in Silesia, Bohemia; also in Devonshire and Cornwall.
Rose-red, also brownish, greenish, or yellowish.	Vit., transpt. to ope. May be cut and polished.	Fuses with Bx in outer flame, hyacinth red bead.	Piedmont, the Hartz, Sweden, Urals, Algiers, United States.
Rose-red. Sk. uncoloured.	Vit. or pearly. Translt. to sub-translt	Effervesces with an acid.	Found in Ag and Cu mines, Saxony, Hungary, Transylvania.
H = 5—6. G = 6—7.5.			
Tin-white. Sk. greyish-white.	Co or Fe is often present.	Gives off fumes of As. Reddish-brown bead with Bx.	Saxony and Austria.
Silver-white or steel-grey. Sk. greyish-black.	Met. or dull met. Fracture uneven. Brittle.	Fusible. De-crepitates. Gives off fumes of As and S, and deposits sulphuret of As.	Sweden and the Hartz.

NAME	Crystalline Form and Cleavage.	Hardness.	Specific Gravity.	Chemical Composition.
COPPER NICKEL.	III. Ret. Gran. dendritic massive, rarely in crystals.	5-5.5	7.5	Ni As (Ni = 44 p.ct.)
**NICKEL PYRITES (Millerite).	III. In rhombohedrons and capillary crystals.	3.5	5.28	¹ / _{Ni} (Ni = 64 p.ct.)
COBALTINE (Cobalt-glance).	I. In hemihedral forms, pentagonal dodec. $\frac{ooOn}{2} + ooOoo$.	5.5	6	¹ / _{Co + Co As} (Co = 35 p.ct.)
SMALTINE.	I. In cubes and combinations. $ooOoo + O. Cl.$ octl. dist.	5.5	6.4-7.3	Co As (Co = 20 p.ct.)
**ERYTHRINE (Cobalt-Bloom).	V. In rad. crystals. Foliated, also incrusting cl. very per.	1.5-2.5	3	$(\ddot{Co})_3 \overset{\cdot\cdot\cdot}{As} + 8 \overset{\cdot}{H}$ (Co = 37 p.ct.)
COBALT-PYRITES (Linnaeite).	I. In cubes cl. cubical per.	5.5	4.8	¹ / _{Co + Co₂}

Colour and Streak.	Lustre, &c., and State of Aggregation.	Tests. Blow-pipe characters, &c.	Localities, and Mode of Occurrence.
Reddish-grey or pale copper-red.	Met. Brittle. Sb may replace some As.	Soluble in Nitric Acid not attacked by HCl.	Found with Co ores, in the dislocated portions of veins; Saxony, Hesse.
Brass-yellow, becomes grey on exposure.	Met. Ope.	Yields \ddot{S} in an open tube. Melts to a black magnetic globule.	Occurs in the Iron districts of South Wales; also in Bohemia and Saxony.
Silver-white, sometimes reddish.	Met. Ope.	Yields with Bx a blue bead.	Occurs at the junctions of cross veins; Cornwall, Sweden, Norway
Tin-white to steel-grey. Sk. greyish-black.	Submet. Brittle. Fracture uneven.	Fusible. Gives off fumes of As. Blue bead with Bx.	Occurs with the ores of Ag and Cu. Redruth (Cornwall), Scandinavia, Freiberg Annaberg (Saxony), and Joachimstal (Bohemia).
Pink or peach colour. Sk. paler.	Lamæ. have pearly lustre, earthy kinds dull. Transp. to subtransl.	See Smaltine.	It is a product of the decomposition of other ores of Co. Found in South of Waterford, Cornwall, Saxony, Thuringia, Baden.
Grey or pale red. Sk. greyish-black.	Brilliant. Brittle.	Fuses on charcoal with odour of As. Heated in open tube yields \ddot{As}_2 and S.	Sweden, Norway, Prussia.

NAME	Crystalline Form and Cleavage.	Hardness.	Specific Gravity.	Chemical Composition.
GROUP IX.—Zn — Sn.				
BLENDE.	I. In rhombic dodec., and in tetrahedrons, also $ooOoo + \frac{O}{2}$ and $ooO + mOm$. Cl. dodec ^l . per.	3·5–4	4	$\overset{.}{Zn}$ (Zn=66 p.ct.)
ZINCITE (Red Zinc ore).	IV. In lam. masses, micaceous, cl. per.	4–4·5	5·5	$\overset{.}{Zn}$ (Zn=80 p.ct.)
SMITHEONITE.	III. In minute rhombohedrons, cl. rhombohedral per	5	4·2–4·5	$\overset{.}{Zn} \ddot{C}$ (Zn=52 p.ct.)
CALAMINE.	IV. In col prisms. Crystals often differently modified at the two extremities. Cl. parallel to sides of prism.	4·5–5	3–3·5	$(\overset{.}{Zn})_3 \ddot{Si} + \overset{.}{H}$ (Zn=52 p.ct.)

Colour and Streak.	Lustre, &c., and State of Aggregation.	Tests. Blow-pipe characters, &c.	Localities, and Mode of Occurrence.
H=4·5 — 6. G=3·5 — 5·5.			
Brownish-yellow, dk. brown and black. Sk. white to reddish brown.	Res. or waxy, cl. faces brilliant. Transpt. to subtranslt. Brittle.	Decrepitates, but does not fuse. Soluble in Nitric Acid. Becomes electric by friction. Some kinds emit light when rubbed with a feather.	Occurs in rocks of all ages, and accompanies ores of Pb, Cu, Sn, Ag. Cornwall, Derbyshire, the Hartz Mountains, Saxony.
Deep red. Sk. orange-yellow.	Admt. to semi-met. Translt. to subtranslt.	Infusible alone. Fuses with Bx to yellow transpt. bead.	Franklin (New Jersey).
Dk. grey, green, or bluish.	Vit. or pearly, or dull and earthy. Subtranspt. to translt. Brittle.	Infusible. Effervesces with Nitric Acid. Becomes electric by friction.	Occurs generally with Blende, and with ores of Pb. Bristol, Derbyshire, Belgium, Silesia, Spain, Siberia.
White, grey, brown, or black. Sk. uncoloured.	Vit. or sub-pearly. Transpt. to translt. Brittle.	Infusible alone. With Bx yields a clear bead. Becomes electric and phosphorescent when heated.	Occurs in beds and veins with Galena, Blende, Smithsonite, in crystalline slates, Carboniferous Muschelkalk, and Oolitic rocks. Altenberg, at Iserlohn (Westphalia), Bleiberg (Carinthia), Chessy (France), Leadhills, Mendip Hills, Matlock (Derbyshire).

NAME	Crystalline Form and Cleavage.	Hardness.	Specific Gravity.	Chemical Composition.
GOSLARITE (White Vitriol).	IV. In prms.	2-2.5	1.9	$\dot{\text{Zn}} \ddot{\text{S}} + 7 \dot{\text{H}}$
*AUTOMOLITE.	I. In oct. Resembles Spinel.	8	4-4.6	$\dot{\text{Zn}} \ddot{\text{Al}}_2$
FRANKLINITE.	I. In oct. and dodec.; also gran. massive.	5.5-6.5	4.8-5	$\dot{\text{Zn}} [\ddot{\text{Fe}}_2 \ddot{\text{Mn}}_2]$
*CASSITERITE (Tin-ore).	II. In pyrds. of different values and combinations of pyrds. and prms.; also mPn + ooPn. In twin and geniculated crystals. Massive and in grains as Stream Tin. Cl. indist.	6-7	6.5-7	$\ddot{\text{Sn}}$ (Sn = 78 p.ct.) Mn and Fe may be present.
TIN-PYRITES (Stannine).	I. In cubes and massive.	4	4.3-4.6	$\overset{'}{\text{Cu}}_2 + \overset{'''}{\text{Sn}}_2$ $\overset{'''}{\text{Fe}}_2$ (Cu = 30 p.ct.)

Colour and Streak.	Lustre, &c., and State of Aggregation.	Tests. Blow-pipe characters, &c.	Localities, and Mode of Occurrence
White. aste astrin- ent. Dk. green black. s. grey.	Vit. Brittle. Vit., inclin- ing to res. Brittle.	Soluble in H. Efflorescent. Infusible alone. Slightly fusi- ble with Bx.	It is the result of the decomposition of Blende. Wales, Sweden, the Hartz. Occurs granular, disseminated, or in crystals in granite with beryl, garnet, &c. Found in Sweden, near Fahlun. Massive at Silfberg and at Garpenberg with quartz.
Iron-black. s. reddish own.	Dull met. Ope. Brittle. Fracture conchoidal to uneven.	Infusible, but emits a strong light. Yields white Zn on char- coal.	Occurs with red Oxide of Zinc in New Jersey.
Lt. yellow- grey, own, or ack.	Crystals have admt. lustre. Also res. Sub- transpt. to ope.	Infusible alone, but re- duced to met. state with Na C.	Occurs in granite, gneiss, and mica-slate in Cornwall, with Copper and Iron Pyrites, Topaz, Wolfram, Tourmaline, Mica, &c. Also in Saxony, Austria, Malacca, Pegu, Banca, Mexico, Brazil, Chili.
Steel-grey. s. black.	Fracture uneven, small conchoidal. Brittle.	Fusible at a high heat, and deposits white Per- oxide of Tin.	Very rare, known as "bell metal ore." St. Michael's Mount (Cornwall).

NAME.	Crystalline Form and Cleavage.	Hardness.	Specific Gravity	Chemical Composition.
GROUP X.—Pb.				
GALENA.	I. In cubes and cube + oct. ; also O + ooO ; also gran. Cl. cubic per.	2·5	7·5-7·7	$\overset{\cdot}{\text{Pb}}$ (Pb = 75 p.cts.)
*MINIUM (Red Lead).	Amorphous, pulverulent.	2-3	4·6	$\overset{\cdot\cdot}{\text{Pb}}_3$ (Pb = 90 p.ct.)
CERUSITE (White Lead Ore).	IV. In rhombic prms. Often in twin crystals and massive.	3-3·5	6·4	$\overset{\cdot}{\text{Pb}} \overset{\cdot\cdot}{\text{C}}$ (Pb = 77 p.ct.)
ANGLESITE.	IV. In prms., also massive and lam. Cl. imper.	2·7-3	6·25	$\overset{\cdot}{\text{Pb}} \overset{\cdot\cdot}{\text{S}}$ (Pb = 68 p.ct.)
CECOISITE.	IV. In tab. prms. Massive and col.	2·5-3	6	$\overset{\cdot}{\text{Pb}} \overset{\cdot\cdot}{\text{Cr}}$ (Pb = 64 p.ct.)

Colour and Streak.	Lustre, &c., and State of Aggregation.	Tests. Blow-pipe characters, &c.	Localities, and Mode of Occurrence.
= 2—4. G = 6—7.5.			
Colour and . lead-grey.	Shining met. Rather sectile.	Decrepitates and fuses, giving off S, and leaving a metallic bead.	Found in carboniferous limestones of North of England, with calcite, barytes and fluor-spar; also in clay-slate rocks. Occurs with the ores of Ag in the Hartz. Other localities are Belgium, Bleiberg (Carinthia), Linares (Spain).
Dull yellow bright red.	Weak vit. or dull. Fracture even or flat, conchoidal or earthy.	Reduced to met. state on charcoal. A yellow oxide deposited.	Found associated with Galena.
White or greyish.	Between admt. and silky. Brittle.	Decrepitates and fuses. Effervesces with acids.	Often pseudomorphic after Galena, Fluor Anglesite. Bleiberg (Carinthia), Zellerfeld (Hartz), Tarnowitz (Silesia), St. Agnes (Cornwall), and in Derbyshire.
White, grey, or black.	Admt., vit., or res. Transpt. to ope. Brittle.	Reduced to met. state with Na ₂ CO ₃ .	It is the result of the decomposition of Galena. Occurs at Leadhills and in Anglesea.
Bright red. Shk. orange-yellow.	Admt. Translt. Sectile.	Blackens and fuses when heated. Soluble in Nitric Acid.	Occurs in veins of quartz in granite in the Au mines of Siberia and in Brazil.

NAME.	Crystalline Form and Cleavage.	Hardness.	Specific Gravity.	Chemical Composition.
PYROMORPHITE.	III. In hexagonal prisms. Cl. lateral imper.	3·5-4	6·5-7	$(\text{Pb})_3 \ddot{\text{P}} + \text{P}$
GROUP XI.—Cu — F				
*NATIVE COPPER.	I. In masses of aggregated crystals, also capillary, ret., and arborescent.	2·5-3	8·5-9	Cu with a little
*CHALCOPRITE (Red Copper Ore).	I. In cubes and oct., also massive and earthy. Cl. octahedral.	3·5-4	6	$\dot{\text{Cu}}_2$ (Cu=88 p.)
TENORITE (Black Copper Ore).	Pulverulent, and in bot. concretions.		5·2	$\dot{\text{Cu}}$ (Cu=70 p.)
COPPER-GLANCE (Redruthite).	IV. In rhombic prisms, with OP, also massive. Cl. parallel to faces of prism.	2·5-3	5·5-5·8	$\dot{\text{Cu}}_2$ (Cu=77 p.)

Colour and Streak.	Lustre, &c., and State of Aggregation	Tests. Blow-pipe characters, &c.	Localities, and Mode of Occurrence.
Yellowish-green to dark green. Sk. white or yellowish.	Res. Subtransp. to subtransl. Brittle.	Swells up and changes colour when heated.	Found at Bleistadt (Bohemia), Freiberg, Johann-Georgenstadt (Saxony), Wolfach (Baden) Beresowsk (Siberia), Cornwall, Cumberland, Durham, Derbyshire, Leadhills, and Wanlockhead.

H = 2—4. G = 3·6—5·5.

Copper-red.	Met. Ductile and malleable.	Fuses readily. Soluble in Nitric Acid, the solution turning blue on addition of Ammonia.	Occurs in veins and beds with Cuprite, Redruthite; also disseminated in various rocks. Herrugrund, Schmolnitz (Hungary). In Cornwall, in mines near Redruth; Chessy, near Lyons; Lake Superior, Cuba, Chili, Japan. Cornwall, Chessy (France), Siberia, Cuba, Brazil.
Deep red. Sk. brownish-red.	Admt. to submet. sometimes earthy. Subtransp. to subtransl. Brittle.	Yields a met. bend when heated on charcoal.	
Black or dk. steel-grey.	Dull and earthy, sometimes met. Thin folia. transl.	See Cuprite.	
Dk. grey. Blue or green when tarnished.	Dull. Very sectile. Fracture conchoidal to uneven.	Fuses readily, giving off S, and leaving a bead of Cu. Soluble in H ₂ N ₂ .	
			Found in Cornwall, and in the crater of Vesuvius.
			Cornwall, Siberia, Hesse, Chili.

NAME.	Crystalline Form and Cleavage.	Hardness.	Specific Gravity.	Chemical Composition.
COPPER PYRITES (Chalcopyrite).	II. In double pyrrds., and in Sphenoids. Also bot., mam., and massive. Cl. indist.	3·5-4	4-1	$\dot{\text{Cu}}_2 + \overset{'''}{\text{Fe}}_2$ (Cu = 34 p.ct.)
TETRAHEDRITE (Grey Copper) (Fahlerz).	I. In tetrahedrons. Cl. octahedral imper.	3-4	4·7-5·1	$\dot{\text{Cu}}_2 + (\text{Sb As})_2 \text{S}_4$ (Cu = 38 p.ct.)
*SULPHATE OF COPPER (Blue Vitriol).	VI. In oblique prms. Also as an efflorescence and incrusting.	2-2·5	2·2	$\dot{\text{Cu}} \ddot{\text{S}} + 5 \dot{\text{H}}$
MALACHITE.	V. Usually occurs as an incrustation, and in bot. or pseudomorphic forms.	3·5-4	4	$\dot{\text{Cu}}_2 \ddot{\text{C}} + \dot{\text{H}}$
AZURITE (Chessylite).	V. In short prms. Also massive and earthy. Cl. lateral per.	3·5-4·5	3·5-3·8	$2 \dot{\text{Cu}} \ddot{\text{C}} + \dot{\text{Cu}} \dot{\text{H}}$ (Cu = 68 p.ct.)
CHRYSOCOLLA.	Bot., mam., and massive, also incrusting.	2-3	2-2·3	$(\dot{\text{Cu}})_3 (\ddot{\text{Si}})_2 + \dot{\text{H}}$

Colour and Streak.	Lustre, &c., and State of Aggregation.	Tests. Blow-pipe characters, &c.	Localities, and Mode of Occurrence.
Brass-yellow or deep yellow. Sk. dk. grey or black	Met. Brittle.	Fuses, and leaves a bead, which is slightly magnetic.	Occurs in beds with Blende, Galena, Mispickel; in veins with Quartz, Calcite, Fluor, &c. Fahlun (Sweden), Norway, and Hungary. Abundant in Cornwall, in veins, in granite and clay-slate.
Steel-grey to iron-black. Sk. the same.	Brittle. Fracture conchoidal to uneven.	Gives off fumes of As and Sb, leaving a met. bead of Cu. Soluble in Nitric Acid.	Cornwall, Andreasberg (Hartz), Kremnitz (Hungary), Nassau.
Lt. blue to dk. blue. Sk. uncoloured.	Vit. Subtranspt. to translt. Taste astringent met.	Soluble in H. Metallic Cu is deposited on Fe dipped in the solution.	Occurs as the result of the decomposition of the sulphides of Copper in Sweden and the Hartz.
Lt. green. Sk. paler.	Crystals have adm. lustre, and are translt, In-crusting varieties silky, earthy kinds dull.	Soluble in Nitric Acid. Decrepitates and blackens when heated. Is reduced to met. state on charcoal.	It accompanies the ores of Cu. Cornwall, Chessy, Tyrol, Siberia.
Azure blue to dk. blue. Sk. bluish.	Vit. Transpt. to subtranslt. Brittle.	See Malachite.	Found principally at Chessy. Also occurs in Cornwall, Siberia, and Australia.
Bluish-green.	Shining or dull and earthy.	Blackens when heated, but does not fuse.	Cornwall, Hungary, Thuringia, the Urals, Burra-Burra Mines, South Australia.

NAME.	Crystalline Form and Cleavage.	Hardness.	Specific Gravity.	Chemical Composition.
*NATIVE MERCURY.	Occurs in fluid globules.	0	13-14	Hg
*CINNABAR.	III. In rhombohedrons with triangular terminal planes. Cl. highly per.	2-2.5	6.7-8.2	$\frac{1}{2}$ Hg (Hg = 86 p.ct.)

GROUP XII.—Ag.

*NATIVE SILVER.	I. Rarely in crystals, usually in capillary and arborescent forms, or in lamæ.	2.5-3	10.3-10.5	Ag with a little Cu
SILVER-GLANCE.	I. In dodec., and in cubes; also ooOoo + O and capillary.	2-2.5	7.1-7.4	$\frac{1}{2}$ Ag (Ag = 87 p.ct.)
STEPHANITE (Brittle Silver Ore).	IV. In very small prisms, with pinacoid and basal planes.	2-2.5	6.2	$(\frac{1}{2}Ag)_3Sb$ (Ag = 70 p.ct.)
PYRRARGYRITE (Dk. red Silver Ore) (Ruby-Silver).	III. In rhombohedrons and scalenohedrons.	2.5	5.7-5.9	$(\frac{1}{2}Ag)_3Sb$ (Ag = 59.8 p.ct.)

Colour and Streak.	Lustre, &c., and State of Aggregation.	Tests. Blow-pipe characters, &c.	Localities, and Mode of Occurrence.
Silver-white.	Shining met.	Volatilizes completely when heated.	Found in clay-slate of Carboniferous age in Idria. Also occurs at Almaden (Spain) and in Mexico.
Pale red to deep crimson. Sk. red.	Crystals admt., sometimes glistening or earthy. Sectile.	Volatilizes and gives off S.	Occurs in rocks of Coal-measure period. Found chiefly at Almaden, in Valencia, the Palatinate, Idria, Mexico, California, Peru.
H = 2—3 G = 5·5—7·1.			
Colour and Sk. silver-white.	Shining met. Sectile and malleable.	Soluble in Nitric Acid, and is precipitated from the solution by Cu.	Occurs in veins in crystalline slate rocks, granite, gneiss, &c., with As and various ores of Ag. Kongsberg (Norway), Sahla (Sweden), Freiberg, Schneeberg (Saxony). Has been found in Cornwall. Most abundant in Chili, Mexico, Peru.
Colour and Sk. dk. grey.	Met. to vit. <u>Very sectile.</u>	Reduced to met. state, S being given off.	Annaberg, Kremnitz, Freiberg, Mexico.
Iron-grey.	Met. Brittle. Ope. Sectile.	Yields fumes of S and Sb when heated, and is reduced to met. state with Na C̄.	Occurs in veins in crystalline slate rocks, and in trachyte with Au, As, Pt, Ag, Quartz, Calcite, Fluor, &c. Found in the mining districts of Freiberg, Schneeberg, Johann-Georgenstadt.
Black or red. Sk. dk. red.	Ope. Translt. at the edges.	Fumes of S̄ and Sb given off when heated. Easily fusible.	Occurs in the Bohemian mines, in Saxony, and Mexico, and at Callington in Cornwall.

NAME.	Crystalline Form and Cleavage.	Hardness.	Specific Gravity.	Chemical Composition.
PROUSTITE (Light red Silver Ore).	III. In acute rhombohedrons.	2-2.5	5.4-5.6	$(\text{Ag})_3 \text{As}$ (Ag = 65.4 p.ct.)
*CHLORIDE OF SILVER (Horn Silver).	I. In very minute cubes, and in disseminated specks; also massive and incrusting.	1-1.5	5.5	Ag Cl (Ag = 75 p.ct.)

GROUP XIII.—

GOLD.	I. In very small and imper. crystals ooOoo + O + ooO. Occurs also capillary and arborescent. Also disseminated in grains. No cl.	2.5-3	17-19.4	Au (with some Ag)
PLATINUM.	I. Very rarely in minute cubes. Generally in angular shining grains, or in small lumps. No cl.	4-5	17-21	Pt (with Ir, Pd, &c.)

Colour and Streak.	Lustre, &c., and State of Aggregation.	Tests. Blow-pipe characters, &c.	Localities, and Mode of Occurrence.
Colour and Sk. cochineal red.	Semi-transpt. Translt. at the edges.	Fumes of S and As given off when heated. Soluble in Nitric Acid.	Schneeberg, Annaberg, Freiberg, Marienberg (Saxony), Wolfach (Baden); in Spain, Mexico, and Peru.
Grey or greyish-green. Sk. shining.	Res. or waxy. Translt. Sectile, often striated.	Fuses readily, and is easily reduced to met. state on charcoal.	Found in the mines of Hungary, the Hartz, Saxony, Mexico, and Peru.

Au—Pt—Ir—Pd.

Gold-yellow to brass-yellow.	Met. Translt. in thin leaves. Very ductile and malleable. Fracture hackly.	Fusible with difficulty. Dissolves in Aqua Regia, forming a yellow solution.	Found disseminated in quartz veins, in igneous and volcanic rocks; also in alluvial deposits and sands. The Hartz, Tyrol, Hungary, Bohemia, the Urals, Mexico, California, Peru, Brazil, Australia, Van Diemen's Land, New Zealand. It is generally accompanied by Pt, Ir, Zircon, Diamond Rutile, Magnetite, Tinstone, Iron and Copper Pyrites.
Steel-grey, or silver-white. Darker coloured when Fe or Cu is present.	Met. shining. Ductile and malleable. Fracture hackly.	Infusible, and slightly magnetic. Soluble in Aqua Regia, forming a red solution.	Occurs disseminated in sand in the Urals. Also found in Borneo, St. Domingo, Brazil.

NAME.	Crystalline Form and Cleavage.	Hardness.	Specific Gravity.	Chemical Composition.
IRIDIUM.	I. Rarely in crystals, generally in rounded grains.	6-7	22-23.4	Ir (with Pd, Os, Cu)
OSMIRIDIUM.	III. In very small tab. crystals, or in loose grains. Cl. basal rather per.	7	19.3-19.4	Ir Os
PALLADIUM.	I. Rarely in small oct. Generally in small grains or scales.	4.5-5	11.8-12.2	Pd (with Pt and Ir)

Colour and Streak.	Lustre, &c., and State of Aggregation.	Tests. Blow-pipe characters, &c.	Localities, and Mode of Occurrence.
Silver-white or yellowish.	Met.	Infusible. Insoluble in Aqua Regia.	Found in the Urals.
Tin-white.	Met. Slightly malleable, but rather brittle.	Infusible alone. Yields Os vapour and odour when fused with Nitre.	Occurs with Au and Pt in the Ural Mountains; also found in Brazil and California.
Lt. steel-grey or silver-white.	Met. shining. Malleable.	Infusible. Soluble in Nitric Acid, forming a brownish-red solution.	Occurs with Au in greenstone in the Hartz; also occurs in Brazil.

INDEX.

Albite	PAGE 56	Diallogite	PAGE 76	Orpiment	PAGE 68
Allophane	50	Diamond	80	Orthoclase	54
Alum	40	Diaspore	42	Osmiridium	94
Alunite	40	Dolomite	38	Palladium	94
Amber	80	Epidote	58	Prehnite	52
Analcime	62	Epsom Salts	38	Pectolite	44
Anatase	64	Erythrine	78	Petalite	56
Andalusite	64	Euclase	62	Pinite	50
Anglesite	84	Fluor Spar	38	Pitchblende	66
Anhydrite	36	Fold. Tellurium	66	Platinum	92
Anorthite	56	Franklinite	82	Proustite	92
Antimony-Glance	70	Galena	84	Psilomelane	76
Apatite	38	Garnet	58	Pyrrargyrite	90
Apophyllite	50	Glauber Salt	32	Pyrolusite	74
Aragonite	36	Gold	92	Pyromorphite	86
Augite	46	Goslarite	82	Pyrrhotine	72
Automolite	82	Graphite	30	Quartz	42
Axinite	60	Gypsum	36	Realgar	68
Azurite	88	Halloysite	48	Red Hematite	70
Barytes	34	Harmotome	52	Rhodonite	76
Beryl	62	Hanssmannite	74	Rutile	64
Bismuth-Glance	68	Heulandite	50	Sal-ammoniac	32
Bismuthite	68	Hornblende	48	Saltpetre	32
Bismuth-blende	68	Idocrase	58	Scapolite	56
Bitumen	30	Iolite	60	Scheelite	66
Blende	80	Iridium	94	Schiller-Spar	46
Boracite	40	Iron Pyrites	72	Serpentine	44
Borax	34	Kyanite	54	Sillimanite	54
Braunite	74	Labradorite	56	Silver-Glance	90
Brookite	62	Lapis-Lazuli	62	Smaltine	78
Brown Hematite	74	Lassiterite	82	Smithsonite	80
Brucite	88	Launtonite	50	Spathic Iron Ore	72
Calamine	80	Lazulite	40	Spinel	48
Calcite	36	Leucite	54	Sphene	64
Cassiterite	82	Magnetite	38	Spodumene	58
Celestine	34	Magnetite	70	Staurolite	54
Cernsite	84	Malachite	88	Steatite	44
Chabazite	52	Mica	60	Stephanite	90
Chloride of Silver	92	Manganite	74	Stilbite	50
Chlorite	44	Meerschaum	46	Strontianite	36
Chondrodite	48	Minium	84	Sulphur	82
Chromite	74	Molybdenite	64	Sulphate of Copper	88
Chrysoberyl	62	Mispickel	72	Talc	44
Chrysocolia	88	Natron	32	Tenorite	86
Chrysolite	48	Native Antimony	70	Tetrahedrite	88
Cinnabar	90	Native Arsenic	68	Thomsonite	52
Coal	80	Native Bismuth	66	Tin Pyrites	82
Cobalt Pyrites	78	Native Copper	86	Tetradymite	66
Cobaltine	78	Native Iron	70	Topaz	60
Cloanthite	76	Native Mercury	90	Tourmaline	58
Common Salt	34	Native Silver	90	Turquoise	40
Copper-Glance	86	Native Tellurium	64	Virianite	74
Copper Nickel	78	Natrolite	52	Wad	76
Copper Pyrites	88	Nepheline	56	Wavellite	40
Copperas	72	Nephrite	46	White Antimony	70
Crocoisite	84	Nickel-Glance	78	Witherite	34
Corundum	40	Nickel Pyrites	78	Wolfram	66
Cryolite	40	Nitrate of Soda	82	Wollastonite	42
Cuprite	86	Okanite	44	Zincite	80
Datholite	42	Oligoclase	56	Zircon	62

